"Excuse me, do we put a border around it?" – The culture of learning that provides opportunities for students to learn or not learn in middle school classrooms.

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ABSTRACT

This study examines the way that middle school students' classroom experience shapes how they learn. The ways that the culture of learning created in the classroom provides opportunities for students to learn or not learn are explored in two different instructional contexts - science and social studies. The significance of teacher and student behaviour in establishing and maintaining classroom culture is examined. Extensive qualitative and quantitative methods, and comprehensive coding and analyses of data, provide detailed accounts of individual students' experiences within each context. Interview data reveal significant differences between students' and teachers' perspectives on teaching and learning, and in the unique ways individuals experience the classroom.

Findings contest the notion that differences in the way students learn is the direct result of differences in ability, but suggest that such differences are likely to result from an interactive relationship between academic ability and classroom experience. It is argued that how students learn to learn is primarily a socio-cultural process. Whether a student learns or not depends on their understanding of classroom tasks; their management of social relationships; the extent to which they share the cultural understandings and prior knowledge of the teacher and other students; their social status, and the opportunities they take or create for their own learning. The implications are that in order to increase the effectiveness of classrooms, changes are required in the ways classrooms function. Constructivist principles articulated by teachers need to be implemented in their practice. Opportunities for all students to be agentive in classroom decision-making processes, and the provision of opportunities for cognitive engagement in authentic tasks within an inclusive community of learners, are discussed.

CHAPTER 1

INTRODUCTION

Interviewer:	Rewa, let's start talking about your memory now. Is it easy for you to remember things?
Rewa:	If they're interesting enough.
I:	Do you have to do a lot of practising to remember things or learn things?
R:	Not really, cause once it's in my head it's hard for it to die.
I:	How far back can you remember?
R:	On my birthday one time, my mum put one candle on my cake when I was turning about three. I got really angry at her.
I:	So you were three. How old are you now?
R:	I'm ten.
I:	You're ten. So you can remember that back seven years ago, because birthdays are very important aren't they?
R:	Mmm.
I:	Rewa, can you remember any particular work that you've done at school since you first started way back over five years ago, that you've been really proud of? Something that you think would really stand out as your best work?
R:	Mmm. No.

The above extract is from an interview conducted with Rewa, one of 32 subjects selected from the four Year 5 and 6 classes who participated in the Project on Learning. Under the direction of Professor Graham Nuthall, the Project on Learning was a three-year research project comprising eight classroom-based studies of children's learning.

To the casual observer, Rewa could be considered to be typical of many ten-year old girls. In the context of the classroom Rewa is observed to interact socially with her peers, has a preference for working in small groups with her friends, is generally attentive, and mostly complies with teacher requests. She also spends considerable periods of time selecting an appropriate felt pen or coloured pencil from the large, well-stocked pencil case that appears to be an essential accessory for many girls of her age.

What, if anything, is remarkable, about this particular interview extract? While we may like to think the efforts of Rewa's teachers over her first years of schooling would have resulted in her producing something that she felt proud of, can many students of Rewa's age recall such events, and does it really matter?

While the dialogue may be unremarkable, the fact that it actually took place is not. In over 20 years as a busy classroom practitioner, often with teaching responsibility for 30 plus students, I had rarely thought to ask the type of questions that would help me get to know my individual students to the extent that I could plan learning opportunities that would accommodate their unique backgrounds, interests, prior knowledge and experience. The time and the resources required to observe or record data that would assist me to fully understand the reality of classroom life for individual students were not available. Even if they had been I doubt whether I was sufficiently aware that it was something I should do, or would even want to do. On reflection, I had a sense of getting a little closer to knowing individual students while teaching in special education for the last eleven years of my classroom-teaching career. Even with a much lower student–teacher ratio however, the demands and challenges of teaching students with specific intellectual, physical, emotional and behavioural needs precluded the type of in-depth observation required to significantly advance my knowledge of individual students. When observations were required to be undertaken, we called in the specialists. Months later the school would receive a report that was duly filed away.

The fact that my practice was no different from most of my colleagues confirmed to me that I was carrying out my teaching duties in accordance with acceptable practice. They didn't observe their students or question them about their thinking or learning either. Although I was constantly interacting with my students, much of our discussion relating to classroom activities was focussed on the superficial aspects such as how much I expected them to do within a specified period, and how I wanted the work to be presented - especially if it was for public display or to be sent home to parents.

So what was my teaching practice comprised of? Much of my practice was based on intuition, experience and my own assumptions about the teaching and learning process. I genuinely thought I understood what classroom life was like for my students. Like so many of my colleagues I was very conscientious. Evenings, weekends and holidays were spent planning topics and activities that I thought would interest and engage my students. I felt confident that such effort would result in providing my learners with a range of activities they

would enjoy and learn from in the way I had expected. On reflection, I was more concerned about knowing the status of my learners' knowledge, which most often involved them simply repeating what I thought it was important for them to know, than I was concerned about knowing my students as unique and individual learners.

My classroom was typical of the busy, interactive classroom, the type of classroom that has often formed the basis for superficial judgements made about quality learning environments. I had been trained to teach in this way, and my practice was evaluated on how well I followed the model. Some of the parents took a little more convincing that their children could still learn without spending the entire day tied to their desks. After all, formal rote learning hadn't harmed them! However, it appeared as though we were heading into a period of enlightenment where many parents were starting to accept the new ways of teaching.

On reflection, my classroom was managed like a stage production. I have often used the analogy of acting when describing my teaching practice. I would climb onto the stage at 9am, and crawl off at 3pm. That was supposing I hadn't been pushed off by some unexpected event, in which case I would have to be the consummate actor, brush myself off, regain my composure and climb back onto the stage again. The students and I all had our roles to play. Like characters in a drama, once we had learned our parts, had accepted who were the major players and the prima donnas, and who were assigned the lesser roles, we generally managed to turn on a creditable performance. The audience of principals, colleagues and parents appeared satisfied with my efforts. Above all, my students seemed happy and willing to come to school. For me, that was the real measure of my effectiveness, so I too was satisfied with my performance in the classroom.

I was also very concerned with managing my students' behaviour. After all, an orderly classroom was a reflection of my 'control' and as the teacher I was expected to be 'in control'. I recall my occasional use of the popular teacher expression "I've got eyes in the back of my head." It worked well with younger students whose actions were often very overt. Occasionally it would even work with older students if I had been quick enough to observe a more covert behaviour that a student thought would go undetected. In retrospect, I probably used the expression to reassure myself that occasionally I did manage to see some of what went on in my classroom and therefore qualified as one of the 'aware' teachers I had read about in textbooks on teaching. It wasn't just my students I was managing to fool.

As I became more experienced, there appeared to be a higher degree of congruence between what I considered would be interesting, worthwhile learning activities and those that my students seemed to find interesting and worthwhile. 'Control' was no longer an issue – I had learned about the application of behavioural theory and the power of antecedents and consequences. Most of the time my students appeared to be on task and engaged with the activities I had given them. I assumed that because I was teaching they must have been learning. I now realise that while my students were busy, interactive and continually learning, much of their learning was most likely to have been unrelated to what I had planned for them to learn, and in many cases, learning for many students would have involved learning how to manage the classroom and their place in it. In particular, I was unaware of the extent to which the many socio-cultural factors inherent in the classroom impact on classroom experience for individual students. I suspect that there was a considerable lack of concordance between my perception of classroom life, and the perceptions of my students. I say 'suspect' as it never occurred to me to ask them.

I take some consolation from the fact that I am not the only teacher to have missed so much of what actually occurred in my own classroom. Much has been written about how in the normal context of the classroom, even the most experienced, sensitive teacher is unable to measure how students internalise and make sense of classroom activities. Teachers are dependent on secondary indicators of the learning process. We observe the overt responses and behaviours such as facial expressions, verbal and non-verbal expressions, and their overt responses to the requirements of the activity. In average size classrooms of 25-30 students, teachers can only sample these secondary indicators from some children some of the time. I now treat such sampling with suspicion. The more I have observed individual students, the less convinced I am that there is such a thing as a representative sample in relation to the unique ways in which the teaching-learning process is experienced.

While I would like to think that further teaching experience and continued involvement in school-based professional development courses could have gradually resulted in improving and developing my understanding of teaching and learning processes, I suspect the reality would be that I would continue to teach in much the same way as I always had. Although I was actively involved in professional reading and collaboration with colleagues, I was teaching in a system that accepted my practice and trusted my experiential and intuitive understandings about teaching and learning. I was complying with Education Review Office (ERO) requirements by providing documentary evidence of my planning. I had class lists with scores next to names and could tick the required boxes. I could talk about teaching and

innovative new practices with some authority - after all I was in a senior position and been "teaching" for 20 years. Theoretically I was accountable to my students, parents and colleagues". The fact that I hadn't really considered my practice in relation to how it might have affected my students' learning seemed to be of no consequence to anyone. In reality, when everything appeared to be going smoothly, there was no accountability.

The turning point

The turning point for me in furthering my understanding of the complexity of the teaching-learning process came as a result of undertaking my Master of Education degree at the University of Canterbury. One of the assignments in Professor Graham Nuthall's Classroom-Based Research course required me to identify the point in time that actual learning occurred for one of my students. For the first time in my lengthy teaching career I had been challenged to undertake detailed classroom observation. As a result I had my first real glimpse of one student's experience while learning a concept, and after 20 years of teaching it was a revelation. I needed to know more.

I had developed great respect for Professor Nuthall's research and teaching as one of his graduate students at the University of Canterbury. The opportunity to subsequently participate as a doctoral student and research assistant in the Project on Learning under his direction was a very exciting prospect. The privilege of being invited by teachers to discuss, observe and record detailed data on their very personal classroom experience and that of selected students finally provided me with the opportunity to observe in-depth the reality of the classroom in a way that had previously not been possible within the constraints of my own classroom practice.

Background to the Project on Learning

The Project on Learning was a three-year research project comprised of a series of eight classroom-based studies of children's learning. The focus of the research project was on how students aged between 9-11 years learn from their classroom experiences and the kind of learning involved in typical science, social studies and language units. The Project on Learning received approximately $390,000 funding from the Marsden Fund, one of eleven funds through which the government funds research that contributes to the global advancement of knowledge. The objectives of the Marsden Fund are to support excellence in research and to broaden and deepen the research skill base in New Zealand. Included in the

funding was provision for two doctoral scholarships. The scholarships were advertised nationally and I was fortunate to be awarded one of them.

Detailing the background to the Project on Learning, Nuthall (1998) stated:

> The Project on Learning has grown out of the research on learning and teaching that we have been doing at the University of Canterbury for the last 30 years. The most recent, has been the Understanding Teaching and Learning Project that has been carried out by Professor Adrienne Alton-Lee as co-director. In each of the studies in the Understanding Teaching and Learning Project we followed the experiences of individual students and identified how they learned from their involvement in classroom activities. This research has been very useful in providing insights into how typical classroom activities affect students' learning.

Rationale and importance of the research

There is a high degree of consensus among contemporary educational researchers of the need for classroom-based research. This is encapsulated in the following quote from Cooper and McIntyre (1996):

> Any serious attempts to improve the quality and effectiveness of teaching and learning in schools must start from an understanding of what people in classrooms do at present. More specifically, the initial and continuing professional education of teachers needs to be informed by understandings both of how experienced teachers do their work and of the ways in which pupils set about their learning. Similarly, the curriculum frameworks within which teachers are asked to plan and conduct their teaching, and the assessment and reporting frameworks through which both teachers and pupils are held accountable for their work, will be sensible and useful only in so far as they take account of how teachers and pupils do their work and why they work as they do (p.1).

The rationale for conducting the classroom-based studies in the Project on Learning is discussed by Nuthall (1999):

> There is a need for classroom based research that can provide the teacher with the knowledge she needs to not only responsively adopt known methods but also to create new methods and procedures that are sensitive to the uniqueness of her classroom and the individuality of her students. The classroom is likely to be one of the major sites in which students acquire and develop those deeply embedded and largely unconscious cognitive processes that are the basis of knowledge acquisition and construction. If we are to understand what students learn from their classroom experience, we must identify and understand how cognitive learning processes are themselves acquired. The way classroom activities are structured and managed, and the intellectual and social context in which those activities occur, will determine the type and quality of the learning processes and abilities that students acquire. More simply, there is a need to understand how classroom experience shapes students' minds (p.143).

The four most significant expected consequences of the Project on Learning are summarised by Nuthall (1997) as follows:

1. It will add to our understanding of the human learning process. The school classroom provides an ideal environment for conducting the proposed systematic research on the complex learning in 'real life' contexts.
2. The research will provide an understanding of the learning process that is directly relevant to teachers. Because it is located in classrooms and deals with the reality of the context, it will provide teachers with a detailed and sophisticated understanding of how to manage learning more efficiently.
3. The research involves the further development of new research techniques incorporating both descriptive individual case studies and prediction-focused quantitative analysis. Continuous detailed data about individual students can capture the process of learning as it occurs, providing more direct access to the process and its context.
4. It will sustain the high quality of research pioneered in this area by training graduate students in the complexity of this type of research and because it provides a unique resource for the teaching profession as a whole (p.2-3).

Development of my research interests within the Project on Learning

In contrast to many doctoral students who collect their data with a specific question in mind, my initial research interests were not clearly defined, but rather evolved as the data collection proceeded. For a period of two years the research team collected extensive data on all aspects of the classroom experience of students and teachers during eight typical units in social studies and science. I admit to feeling overwhelmed in the early stages of data collection. At times I felt I had seen and heard too much. Everything I was exposed to in the first six months of data collection was of interest. Every individual subject was unique and suitable for a case study approach. Comments made by the subjects and teachers during the interviews all seemed profound and worthy of further exploration. The scope of potential areas of personal focus within the project was almost unlimited. It was all so important and worthy of selection for more in-depth analysis.

During the first six months of data collection, I became increasingly aware of the impact of what the teacher did that caused students to think, act and behave as they did within the context of the classroom. We were observing students' participation in a range of individual, group, and whole class activities. The ways in which teachers planned, implemented and monitored the activities, and the ways in which individual students managed their participation in those activities appeared to significantly impact the teaching–learning process.

On the surface it appeared that some activities were more successful than others in engaging learners and were able to be managed more effectively by teachers. There was a high degree of consistency between the teachers and students in relation to their perceptions of what constitutes effective activities. There appeared to be a strong relationship between how

students perceived they learn best, and those activities they considered involved active participation and challenge; contained elements of personal choice; were interesting, fun and hands-on, as well as being quick and easy to complete. Similarly the teachers shared common perceptions of what constituted effective activities, acknowledging the need to provide a range of classroom activities that incorporate student interest and choice, are fun yet manageable within the constraints of the classroom, are challenging but achievable, and most importantly, will encourage cognitive engagement and result in positive learning outcomes. Often the students and teachers shared common perceptions.

Questions then began to emerge. What influenced the teachers to plan and implement activities the way they did? Why did some students engage with some activities and learn more than other students when they had all been exposed to the same instructions and had the same resources to work with? How important were the instructional phases of lessons in terms of student understanding and subsequent engagement with the activity? How effective were group activities, and how did individual students experience working in groups? What factors accounted for the relationship between student ability and learning?

In a progress report of the Project on Learning (2000), Nuthall commented on some of the important discoveries about children's abilities resulting from the first four studies conducted in 1999. One of the most surprising findings was that the process of learning seemed to be the same for students with quite different levels of academic ability. For example, students with Progress and Achievement (PAT) scores of 20-30 could learn just as efficiently as students with scores of 70-80. It was found that differences were the result of the low PAT score students missing out on many of the learning opportunities used by their more 'able' peers. When these 'low ability' students had the same opportunities, they learned the same concepts and ideas.

> Low ability students were less likely to create their own learning opportunities, had less background knowledge to draw on, were more likely to misunderstand or misinterpret instructions, and were more likely to do what they were told rather than doing 'extra'. They were also less likely to want to help each other, more defensive about their work, were less confident about themselves, and less likely to believe their ideas were worth sharing. We came to the conclusion that differences in children's abilities could be the result of accumulated differences in their classroom experiences. We usually assume that some children learn more than others because they have more ability. But it could be the other way round (Nuthall, 1999, p. 6-7).

This finding was particularly relevant to the fifth study undertaken at the beginning of the second year of data collection and was especially significant in terms of further stimulating

my interest in the impact of classroom experience for individual students. It was during this study that I focussed my observations on the way in which selected students interacted with a range of activities allocated by the teacher during a unit on space. The following observation is of two students as they attempt to interpret the instructions for an activity that required them to make a space encyclopaedia, incorporating 20 words about space nominated by the teacher.

Student A:	What the hell's a cyclopaedia?
Student B:	Encyclopaedia's a book and you find up stuff like space and all that. Hey what does it say? What are you looking at?
Student A:	A space encyclopaedia. What the hell's a cyclopaedia?
Student B:	It's a book.
Student A:	About what?
Student B:	A encyclopaedia's about everything, like space and all that.
Student A:	Yeah, but what does it tell you about space?
Student B:	Well don't ask me. You've got to read. It's true.
Student A:	These blah, blah crappy words!

I spent the remaining 45 minutes of the session observing Student A wandering around the classroom, interrupting his peers while trying unsuccessfully to interpret the activity instructions. Student A's reading age was approximately two years below his chronological age. He simply could not access the written instructions sufficiently to engage with the activity, and at the end of the unit Student A had completed less than 20% of the allocated activities. During the post-unit interview I asked him about his experiences.

Interviewer:	If you've got work to do that's really hard to understand, how does that make you feel as the person who has got to learn it?
Student A:	Well, you start to get a bit grrrrh!
I:	Would that make you feel angry, or anxious, frustrated or scared?
A:	Probably frustrated.
I:	How does it affect kids when they get frustrated?
A:	It makes them more angry and they go around being mean to everybody.
I:	What can teachers do to make sure kids don't get frustrated?
A:	Give some kids work like for their standard, and other kids, work for their standard.

Student A's experience made me understand more about the importance of diagnostic assessment as a starting point for planning to meet individual needs. More importantly it made me aware of the strategies students develop in order to manage the demands of a classroom that presents them with activities they cannot engage with or complete. Such observations made me realise that it wasn't enough to accept that because teachers plan activities to deliver content as specified in the national curriculum, or that even if they have the potential to provide opportunities for cognitive development that they necessarily will. The situation appeared to be far more complex than I had previously considered.

This complexity is inherent in the proposal that classroom activities are more than just the vehicle for transmitting content - they actually determine children's thinking. According to Nuthall (2000):

> If classroom experiences shape the minds of students in some significant way, then it must be the consequence of the students' increasing expertise in managing classroom activities. What become the structures and procedures that constitute cognitive processes must reflect the structures and procedures of classroom activities (p.17).

One of the most compelling aspects of my participation in the Project on Learning has been my increased awareness of the power and importance of the student voice. At the beginning of this introduction I reflected with some regret on how little I really knew about my students and their opinions on teaching and learning. I simply hadn't thought to ask them. One of my priorities during the Project of Learning was to conduct in-depth interviews with the subjects on a wide range of aspects of their individual experience of the classroom. I was surprised at how much these ten and eleven year old students understood about teaching and learning, and how well they could articulate their thoughts. The subjects were equally surprised that someone had asked for their opinion. For most of them it was the first time anyone had asked them about their experience of the classroom. I realised just how much the voices of students can inform our practice if we give them the opportunity to do so.

My participation in the Project on Learning has also increased my awareness of the impact of the many socio-cultural factors continually operating in the classroom. Teachers and students demonstrate a high degree of congruence in their articulation of best practice in relation to teaching and learning. As demonstrated by our data however, the extent to which best practice may be implemented is largely determined by the social processes and cultural structures inherent in the classroom, and their influence in shaping the complex cognitive processes required for knowledge acquisition to occur.

The real strength of the Project on Learning is the extensiveness of the data collection and analysis procedures. The costs in terms of financial resources and the time spent by researchers were considerable but essential in order to capture the realities of classroom experience for individual children. Through tracking the experiences of individual children and teachers in-depth, we are better able to understand how children learn and think. The privilege of working so closely with teachers and children in order to advance what we know about learning, thinking and teaching must be acknowledged.

In summary, it is obvious that children are thinking about what they are doing all the time, therefore teachers need to ensure that what they are giving students to think about is not trivial. It is my contention that in order to meet the diverse learning needs of individual students, teachers must better understand the unique ways that students experience the classroom. As classroom activities continue to be the main vehicle by which teachers deliver the curriculum, teachers must also understand the need to deliberately plan and manage classroom activities in ways that will afford maximum learning opportunities for all students.

My experience in the Project on Learning confirmed for me the need for an analysis of those factors that will result in learning communities in classrooms based not simply on articulation of best practice, but on an actual culture of best practice. It is hoped that the extensive coding and analysis of data collected during the Project on Learning will help to illuminate for teachers and teacher educators, the reality of classroom experience for individual students, and will assist them in their planning and management of classroom activities.

It is not claimed that this thesis provides more than a series of dynamic scenarios in the very complex, continually evolving progression in the understanding of learning. Due to the extensive methodology, however, for the first time I am beginning to see some of the images merging and becoming multi-dimensional. It is not yet a panorama, but at least some of the snapshots appear to be sufficiently linked to justify placing them on the same page in the album.

Overall goals of the thesis:

- to contribute to a better understanding of the complex relationship between teaching and learning;
- to examine the experiences of selected Year 5 and 6 subjects as they negotiate the academic and social life of the classroom;

- to develop a set of (evidence-based) principles of effective activity design and management in typical science and social studies activities for Year 5 & 6 students, teachers, and teacher educators;
- to reduce the lack of concordance between teacher and student perceptions of student classroom experience.

Research questions

This thesis explores the following research questions:

How do the cultures of learning that the teacher creates in two different classroom contexts (science and social studies) provide opportunities for children to learn or not learn in those contexts?

What is it that the teacher does that causes selected Year 5 and 6 students to think, talk, and behave as they do within the context of the classroom?

Thesis overview

This thesis comprises nine chapters and is structured as follows:

Chapter One provides an introduction to the study, including reflections on my teaching career and a discussion of how I came to participate in the Project on Learning. The development of my research interest within the project is described. A brief background to the project is provided, with a discussion of the rationale for conducting the research. The chapter concludes with the selected research questions.

Chapter Two contains the literature review. The chapter begins with a discussion of the theoretical framework for the study. Selected key themes are then discussed with reference to a range of current, and other relevant historical research and published material.

Chapter Three describes the extensive methodology employed in the Project on Learning, including my contribution to the research design.

Chapter Four provides a description of the context for the study. Relevant details of the class and the individual subjects are provided. This is followed by a description of the lessons selected for analysis, including a discussion of the reasons for their selection and an overview of the units in which they were located.

Chapter Five contains qualitative and quantitative analyses of the instructional phases of the selected lessons. Key themes are identified and discussed based on evidence drawn from the extensive recorded, observational and interview data.

Chapter Six contains qualitative and quantitative analyses of the activity phases of the selected lessons. This includes an analysis of the open and closed questions written by four subjects in Lesson One, and an analysis of the subjects' concept learning in Lesson Two.

Chapter Seven draws on data from interviews conducted with the teacher whose lessons have been selected for in-depth analysis. Extracts from the interviews are used to illustrate the following: the teacher's philosophy of teaching and the theoretical principles she subscribes to; management of the learning context, including issues related to planning of units and activities; the teacher's expectation of student performance and encouragement of learner independence; evaluation of student progress, and the constraints that the teacher feels impact the implementation of best practice as articulated in the teacher's philosophy of teaching and learning.

Chapter Eight contains a discussion of the findings.

Chapter Nine concludes the thesis with a discussion of the implications of the research findings for teaching and learning. Areas for further research are indicated.

CHAPTER 2

THEORETICAL FRAMEWORK AND LITERATURE REVIEW

Chapter overview

This chapter is comprised of two main sections. In the first section, relevant theoretical frames to contextualise and amplify the study reported in this thesis are identified and discussed. This section begins by describing how the study is situated within the larger Project on Learning and discusses how it draws for its orientation from the theoretical frame developed for the Project on Learning by Nuthall (1997). Next, an overview is provided for each of the three theoretical perspectives selected to contextualise the study, with reference made to key theorists and associated theoretical principles. The way in which each perspective informs the methodology used in the Project on Learning, and in particular, to my own data collection and analysis is discussed. The second section contains a review of empirical research related to four main themes that have been selected for their relevance to teaching and learning and the classroom context. The themes are ordered as follows: 1) teacher centrality; 2) classroom culture; 3) classroom tasks and activities; and 4) classroom discourse. The review concludes with an integrated summary of the key ideas to emerge from the review that have been used to ground and illuminate my own research.

Introduction and situation of the study within the Project on Learning

The research reported in this thesis is about student and teacher activity within the context of the classroom, and the complexities inherent in the relationship between teaching and learning processes. It is based on the clearly established need to study psychological phenomena in the context in which they occur (Nuthall, 1997), and the belief that "Research can make its greatest contribution to the profession of teaching by providing teachers with an understanding of the ways in which classroom activities affect the lives and development of their students" (Nuthall, 1999, p. 141).

This study is situated within the larger Project on Learning and therefore draws first for its orientation from Nuthall (1997; 1999). The Project on Learning (1999 – 2001) was the last and most comprehensive research project undertaken by Nuthall. The Project on Learning builds on previous research conducted by Nuthall and Alton-Lee (1991; 1992) and their model of learning in the classroom that was designed to help teachers understand how the tasks and activities they designed for students would affect their learning.

The theoretical framework and methodology used in the Project on Learning was informed by the work of Piaget and Vygotsky, and by forty years of research conducted in New Zealand classrooms by Nuthall and his colleagues at the University of Canterbury. The relevance of Piaget's and Vygotsky's work to the Project on Learning is discussed more fully later in the chapter. For detailed accounts of previous studies see also Alton-Lee (1984); Alton-Lee, McBride, Greenslade and Nuthall (1997); Alton-Lee and Nuthall (1990; 1992); Alton-Lee, Nuthall and Patrick (1993); Nuthall and Alton-Lee (1990; 1992; 1993; 1995) and Nuthall (1996a; 1996b; 1996c; 1999a).

Of particular relevance to my own study are the later studies conducted by Nuthall and Alton-Lee, in particular, the "Understanding Teaching and Learning Project" undertaken by Nuthall and Alton-Lee at the University of Canterbury between 1990 and 1997. Comprised of five studies, the "Understanding Teaching and Learning Project" was the precursor to the Project on Learning. The latter three studies sought to validate Nuthall and Alton-Lee's (1993) development of a descriptive model of the learning process as students encountered successive experiences in the classroom. From this model, Nuthall and Alton-Lee developed procedures based on an analysis of the content, sequence, and timing of content-relevant classroom experiences that could be used to predict the specific curriculum content that students would learn and remember twelve months later. One of their key findings was that it was not the behaviours or activities that were consistently related to learning, but the sequence and timing of a student's exposure to relevant information. Learning was found to be a matter of the cumulative effects of experience and that the conditions that affected learning were likely to change as further information was encountered and processed. Their data showed that for learning to be constructed and transferred to the long-term memory, students were required to engage with relevant content on at least three or four occasions with no more than two days between each exposure.

What this model failed to describe is what happens in the long-term working memory that results in the creation of new knowledge constructs. Evidence from students' recollections of their classroom experiences (Nuthall & Alton-Lee, 1995) showed that a full account of representations of classroom experiences must be multidimensional, involving both the verbal/semantic and the visual/pictorial form. In addition, Nuthall and Alton-Lee found that the social, emotional, and cultural aspects of experience were also represented. Nuthall and Alton-Lee's data demonstrated that the classroom experiences of students occurred in three distinct but interacting domains. These included interaction with the curriculum in the public domain of teacher-managed classroom activities, the semi-private domain of small group and individual peer-to-peer interactions, and in the private domain of mental operations.

Based on interviews with Year 5 and 6 students, Nuthall and Alton-Lee reported that students could recall their interactions with peers and the teacher, along with their personal feelings that were part of, and the context for, those interactions. In order to understand more about long-term working memory, Nuthall concluded that there was a need to redesign and expand their original model to incorporate the classroom as part of the working memory. This resulted in a removal of the distinction between working memory and the classroom activities that constitute its social context. Based on their new model of learning, Nuthall (1999) argued that if the processes of individual knowledge acquisition are the product of student participation in the learning activities of the classroom, there must be a transactional relationship between participation in classroom activities and working memory.

Redefining their original model led to a broadening of the original focus to carry out a series of studies that provided a more comprehensive background against which to understand classroom learning. The four major foci were on how learning is assessed, remembering and forgetting, the way schooling shapes students' memory, and how schooling affects student ability. Amongst Nuthall and Alton-Lee's (1997) conclusions were the following:

1. Based on their new model of learning, it was argued that if the processes of individual knowledge acquisition are the product of student participation in the learning activities of the classroom, there must be a transactional relationship between participation in classroom activities and working memory.
2. They could not develop their understanding of how students learn until they understood more clearly how the procedures they were using to assess their learning were actually working.
3. That changes were constantly occurring in the knowledge that students had acquired from their classroom experiences. Forgetting is not merely a simple process of loss. With the passage of time, what is stored in the memory becomes more abstract and general. Prior knowledge and new knowledge interact with each other in constantly changing patterns.
4. Memory processes, like other intellectual processes, are multi-layered. There are several different memory processes that work in parallel to determine what students remember and do not remember from their classroom experiences.
5. The same learning processes occurred in all students in their samples regardless of their levels of academic ability, but that the more able students ended up learning more than less able students. They concluded that differences in achievement were not a function of

differences in learning ability but of differences in culture and that these cultural differences produce cumulative effects.

Nuthall and Alton-Lee's findings were presented in a report to the Ministry in 1997. This report provided a strong rationale for the Project on Learning based on an examination of the realities of the total experience of selected Year 5 and 6 students within the socio-cultural context of the classroom.

In 1998 Nuthall produced an information pamphlet as part of his invitation to teachers to become involved in the Project on Learning. In the pamphlet Nuthall summarised some of his previous findings on which the Project on Learning would be based. In addition to stating the key findings discussed above, Nuthall remarked that many relevant learning experiences are generated by the students themselves, and that they spend a considerable period of time talking informally with each other about the concepts and ideas that come up in class. Nuthall concluded that if the way children's minds process experience is the result of their classroom experiences, and that individual children experience the classroom differently, then differences in children's minds could be the product of differences in their classroom experiences. While it is acknowledged that experiences outside classrooms also play a big part in forming differences in children's minds, the primary focus of the Project on Learning is on children's classroom experiences.

While conducting the "Understanding Teaching and Learning Project" Nuthall also conducted a major review of research on classroom learning in which he identified three different perspectives on the way students acquire knowledge and learn to think in the classroom. These are the cognitive constructivist perspective, the socio-cultural or 'classroom as a community' perspective, and the linguistic perspective.

Nuthall identified substantial areas of conflict among the three perspectives. The first relates to the nature of mind and the mental processes. The socio-cultural, and to some extent the linguistic perspectives, take the view that the way we think and learn is culturally constructed. Our minds are not individual mechanisms but exist in the social processes by which we define and solve problems. Such a radically different view provides a strong challenge to the way we currently conceive of the roles played by teachers and schools. Related to it is a conflict over how the mind develops. Research on intellectual development places much greater emphasis on the role of social interaction.

From his extensive review of the literature on classroom learning, Nuthall (1997) reached the conclusion that the distinctions that are usually made between thinking and learning, and between social, linguistic and cognitive activities, can no longer be sustained. "The evidence is that thinking and learning are essentially the same processes, and they are as much matters of social interaction and of language use, as they are matters of the mind" (p. 11). Nuthall asserted that this conclusion has wide-ranging implications for the classroom. Social organisation of the classroom is as much a curriculum issue as the subject matter content. Students' thinking skills are as dependent on the social interactions they have with their peers as they are on the academic tasks they engage in. It also means that the nature of learning and memory, and academic ability are as much a product of classroom experiences as they are a cause of them.

The constructivist, sociocultural and linguistic perspectives provide the basis of the theoretical frame for informing my own research conducted within the Project on Learning. Underlying their selection is the view stated by Nuthall (1999) that in education, it is essential to see both the individual cognitive and the socio-cultural dimensions of human experience as interactive. "There is a sense in which education is about the transactional relationship that exists between the individual and the socio-cultural" (p. 143).

The cognitive constructivist perspective

Constructivism has received considerable attention in education scholarship in recent years. Research within the cognitive constructivist perspective is in a state of evolution, pushing at the boundaries with developmental research and research on social and cultural processes in the classroom. Central to the cognitive constructivist view of students' classroom experience is the claim that students construct their own knowledge as they engage with classroom activities and try to make sense of the related experiences as they occur. Making sense of experience involves integrating that experience with prior knowledge, resolving apparent contradictions between parts of what is known and what is implied by what is known. It also involves creating new knowledge and new conceptual structures where the existing structures appear inadequate, incomplete, or contradictory. Fundamental to a constructivist perspective is the notion of students as active participants in the learning process (Nuthall, 1997).

According to Palincsar (1998) "Virtually all cognitive science theories entail some form of constructivism to the extent that cognitive structures are typically viewed as individually constructed in the process of interpreting experiences in particular contexts" (p. 347). While there are many versions of constructivism, Palincsar asserts that post-modern constructivist perspectives are unified in their rejection of the notion that the locus of knowledge is in the

individual. From a post-modern perspective "learning and understanding are regarded as inherently social; and cultural activities and tools (ranging from symbol systems to artefacts of language) are regarded as integral to development" (p. 348). This merging of the interdependence of individual and social processes in the co-construction of knowledge has given rise to the social constructivist perspective.

The constructivist perspective has its roots in the work of Jean Piaget. Underlying Piaget's stage theory is his basic view of cognitive development as a process that follows universal patterns. This process is guided by the need in everyone for cognitive equilibrium, that is, a state of mental balance. Each person needs to, and continually attempts to, make sense of new experiences by reconciling them with his or her understanding. Equilibrium is experienced when one's present understanding 'fits' new experience. When it doesn't, the individual experiences disequilibrium, a kind of imbalance that initially produces confusion and then leads to growth, as the person modifies old understandings and constructs new ones to fit the new experience (Berger, 1998). Disequilibrium can be disquieting to children as they suspect accepted ideas no longer hold true. They can also be exciting periods of natural growth, which is one reason why people of all ages seek out new, challenging experiences. "By seeking out novel experiences, children are constantly putting their current understanding to the test. Recognition of this active searching for knowledge is the very essence of Piaget's theory of human cognitive development" (Berger, 1998, p. 42).

Fundamental to Piaget's view of cognitive development is the need for children to be active participants in the learning process, with opportunities to discover, invent and create. This view was articulated by Piaget at the Conference on Cognitive Studies and Curriculum Development (Cornell University, 1964).

> The principal goal of education is to create men who are capable of doing new things, not simply repeating what other generations have done – men who are creative, inventive, and discoverers. The second goal of education is to form minds which can be critical, can verify, and not accept everything they are offered. The great danger today is of slogans, collective opinions, ready-made trends of thought. We have to be able to resist individually, to criticise, to distinguish between what is proven and what is not. So we need pupils who are active, who learn early to find out by themselves, partly by their own spontaneous activity and partly through the material we set up for them; who learn early to tell what is verifiable and what is simply the first idea to come to them (Piaget, 1964, in Ripple & Rockcastle, 1964, p.5).

Piaget makes the following distinction between development and learning. Development is a spontaneous process tied to embryogenesis, whereas learning is provoked by external situations. Piaget identified four factors that contribute to children's intellectual development:

maturation, experience, social transmission, and equilibration. Piaget regarded all four factors as important. For example, maturation plays an indispensable role and cannot be ignored as it takes part in every transformation that takes place during a child's development. However, Piaget did not consider maturation could explain everything because the average age at which maturational stages appear varies greatly between societies. Likewise, experience of objects, of physical reality is a basic factor in the development of cognitive structures. According to Piaget however, this does not explain everything because the notion of experience is an equivocal one with important psychological differences between physical and logical-mathematical experience.

The third factor, social transmission, described by Piaget as linguistic transmission, or educational transmission, is fundamental because the child can only receive valuable information via language or via education directed by an adult if the child is in a state where they can understand the information. To receive the information, the child must have a structure that enables him/her to assimilate the information.

> Words are probably not a short-cut to better understanding...The level of understanding seems to modify the language used, rather than vice versa...mainly language serves to translate what is already understood; or else language may even present a danger if it is used to introduce an idea which is not yet accessible (Piaget, 1964, p. 5).

The fourth factor, that of equilibration, is considered by Piaget to be the most fundamental factor. "In the act of knowing, the subject is active, and consequently, faced with an external disturbance, he will react in order to compensate, and consequently he will tend towards equilibrium" (p.13). Piaget describes equilibration is an active process - one of self-regulation which is a fundamental factor in development.

First hand experience is essential for intellectual development. For Piaget, the teacher has a critical role to play in task and activity design and management. Piaget was critical of a transmission style of teaching arguing that it is not enough for teachers to simply provide students with reading materials or demonstrations. The teacher must provide opportunities for students to be actively engaged in experimentation and deduction in order to decide things for themselves. "A ready-made truth is only a half-truth" (p.5). Piaget also warned of the need for instruction to be carefully paced.

> The goal in education is not to increase the amount of knowledge, but to create the possibilities for the child to invent and discover. When we teach too fast, we keep the child from inventing and discovering himself...Teaching means creating situations where structures can be discovered; it does not mean transmitting structures which may be assimilated at nothing more than a verbal level... If they

> read about, it will be deformed, as is all learning that is not the result of the subject's own activity (p.3).

In order to understand the unique ways that children learn, Piaget (1964) urged teachers, particularly those undergoing their initial teacher training, to spend time questioning children in a one-to-one situation in order to understand how hard it is to understand what children mean, and even more, how hard it is to make oneself understood by children. "Each prospective teacher should work on an original investigation to find out what children think about some problem – and thus be forced to phrase the problem and establish communication with a number of different children to appreciate the true difficulty of talking successfully to a whole class of children at once" (p.4). Such advice is relevant to all teachers, particularly those who use whole class tasks.

Constructivism in the contemporary classroom

Constructivist practice requires a shift in teacher praxis from a formal, transmission style of teaching to one that is student-centred. Tyson (1990) proposes that school structures and routines should be shaped more by students' needs than by the characteristics of the disciplines, and less by teachers' and administrators' need for control and convenience.

Tyson asserts that young children learn best when they become active workers rather than passive learners. Progress will be greater when children are permitted to work together in groups to solve complex tasks, and are able to engage in class discussions and taught to argue convincingly for their approach in the midst of conflicting ideas and strategies.

Consistent with Piaget and Tyson, Sergiovanni (1994) maintains that in order for knowledge to be understood and used, students must be involved in its active construction. "This means not just telling and explaining, but providing students with opportunities to answer questions, to discuss and debate meanings and implications, and to engage in authentic problem-solving in real contexts" (p. 184). Wood (1997) agrees that teaching that teaches children only how to manipulate abstract procedures without first establishing the deep connections between such procedures and the activities involved in the solution of practical, concrete problems is bound to fail.

Constructivism teaches the importance of relating new learning to prior knowledge and the importance of immersing teaching in the world of real or "authentic" learning. Generative learning, learning that is understood and can be used to create new learning, doesn't just take place in a vacuum. It is always contextual. "What is learned depends on one's prior

knowledge; learning takes place best when bridges or scaffolds are developed that link the new with the old" (Sergiovanni, 1994, p. 191).

According to Nuthall (1997), the fact that new experience is filtered through existing knowledge and beliefs, creating significant cognitive changes appears to present a 'paradox', raising the following question:

> How can new knowledge and understanding be created when existing knowledge determines how experience is perceived and understood? Interaction with the knowledge and beliefs of peers within significant social groups appears to play a privileged role in generating new beliefs and knowledge structures (p.10).

Windschitl (1999) appears to resolve this paradox by viewing constructivist teaching and learning as a culture, rather than a fragmented collection of practices. Discussing the challenges of sustaining a constructivist classroom culture, Windschitl states that constructivism places high demands on teachers' subject knowledge, pedagogical skills, and design of independent student projects. Major changes in curriculum, scheduling, and assessment are needed for the effective implementation of constructivist practice.

The socio-cultural perspective

The socio-cultural perspective focuses on the culturally embedded nature of classroom processes and the central role that cultural norms and artefacts play in structuring the nature of learning. Learning is not viewed as the achievement of an individual mind but as the acquisition of the practices and beliefs of a culturally defined community through an apprenticeship in that community. Thinking and mind are primarily social processes distributed across, or spread between, all aspects of the activities and the contexts in which they occur. From this perspective, shaping the nature of the educational process involves shaping the nature of the community in which it occurs. Classrooms are viewed as 'communities of learners', and improving learning involves changing the culture of those classrooms (Nuthall, 1997).

Socio-cultural theory seeks to explain the growth of individual knowledge and competencies in terms of the guidance, support, and structure provided by the broader social context. "The central thesis of socio-cultural theory is that human development is the result of the dynamic interaction between developing persons and their surrounding culture" (Berger, 1998, p. 46). Socio-cultural theory looks at the processes through which individuals develop in a cultural context. It recognises not only the importance of learning and instruction from parents, teachers, peers, colleagues, and mentors in one's immediate environment, but also the ways in which these influences are shaped by the beliefs and goals shared by members of the community and the larger society.

The socio-cultural perspective owes much to the writings of Vygotsky and other Russian writers such as Leontyev and Bakhtin. Russian psychologist Lev Vygotsky was a major pioneer of the socio-cultural perspective. Despite the fact that his active career as a psychologist lasted only about ten years, Vygotsky's views about development provide "a dynamic socially, historically, and culturally grounded view of human development, and a theoretical framework which has particular relevance to education" (Smith, 1998, p.2).

Vygotsky's approach acknowledges the ways in which children's development is profoundly affected by other people, culture, and the tools of culture, especially language, institutions, and history (Nuthall, 1997). Vygotsky rejected the traditional idea that a child's mind contains all its future developments in a complete form waiting for the proper moment to emerge. He argued that children grow into the intellectual life of those around them and that it is important to challenge children in order to advance their intellectual development. Rather than simply providing the child with facts or bits of knowledge that may inhibit independent thinking, the goal of education should be to teach the child to think. Vygotsky (1978) believed that instead of matching teaching to traditional development, teaching should proceed ahead of development in order to awaken and arouse to life those functions in the process of maturing. "The only good learning is that which is in advance of development" (p. 50).

Vygotsky argued that children learn through social action and that collaboration is a powerful source of cognitive development. Higher mental functions develop through collaborative support from an expert 'other'. According to Vygotsky, learning is embedded and fostered in relationships and social situations in which children are engaged in tasks with adults at levels beyond their present independent abilities. Through cooperative dialogues with more knowledgeable members of their society during challenging tasks, children learn to think and behave in ways that reflect the culture of their community. Children are entrenched in social experiences, many of which they participate in or make use of, but which they do not always understand. These experiences are encountered first within the social mores of the particular cultural group and only later do children understand them on a cognitive level. Cognitive functions develop and are transformed within this social interaction.

> Every function in the child's cultural development appears twice; first on the social level, and later on the individual level, first between people (interpsychological) and then inside the child (intrapsychological). This applies equally to voluntary attention, to logical memory, and to the formation of concepts. All higher mental functions originate as actual relations between human individuals (Vygotsky, 1978, p.50).

Vygotsky's concept of the zone of proximal development is a key feature of his theory. The zone of proximal development is defined by Vygotsky (1978) as:

> ...the distance between the actual developmental level as determined by independent problem solving and the level of potential development as determined through problem solving under adult guidance or in collaboration with more able peers (p. 86).

> We propose that an essential feature of learning is that it creates the zone of proximal development; that is, learning awakens a variety of internal developmental processes that are able to operate only when a child is interacting with people in his environment and in cooperation with his peers. Once these processes are internalised, they become part of the child's independent developmental achievement (p. 90).

Although Vygotsky never used the term himself, 'scaffolding' is a metaphor used by Bruner (1976) and his colleagues to refer to the guidance and interactional support given by a tutor in the zone of proximal development. The quantity and quality of the scaffolding support given to the child may vary. Ideally the child, initially a spectator, begins to participate, learn the rules and skills required of the task, and eventually is able to complete the task independently.

In Vygotsky's theory, language is central to children's development. Language is a tool of the mind, and is the most frequently and widely used human representational system. Speech is an essential tool to allow children to plan and carry out actions, and to plan and control their own behaviour. Vygotsky believed that speech accompanies a child's activity and then begins to precede it (to appear before the behaviour it intended to regulate). For Vygotsky, the most significant moment in cognitive development occurs when the child begins to use language not only to communicate with others, but also as a tool of thought – a means to direct his or her own attention and behaviour (Vygotsky, 1987).

For Vygotsky, thought and speech turn out to be the key to the nature of human consciousness as demonstrated in this extract from The Collected Works of L.S. Vygotsky (1987).

> If language is as ancient as consciousness itself, if language is consciousness that exists in practice for other people and therefore for myself, then it is not only the development of thought but the development of consciousness as a whole that is connected with the development of the word...Consciousness is reflected in the word like the sun is reflected in a droplet of water. The word is a microcosm of consciousness, related to consciousness like a living cell is related to an organism, like an atom is related to the cosmos. The meaningful word is a microcosm of human consciousness (p. 285).

New socio-cultural ideas have arisen from the work of contemporary theorists such as Rogoff and Wertsch. As a result of closer collaboration between anthropologists and psychologists, there is now a greater emphasis not just on language, but on the specific importance of

intellectual tools for thinking. Examples include diagrams, writing systems, and numerical systems.

Many contemporary theorists argue that intelligence is distributed across a social group and emerges from collaborative action, rather than being localised in individual members (Smith, 1998). For example, Rogoff (1990) promotes the notion of 'apprenticeship in thinking'. The implicit goal of apprenticeship is to provide support for acquiring the knowledge and capabilities that are valued by the culture. Rogoff proposed a learning community in which novices are supported and scaffolded in their learning by more expert others. Through collaboration with skilled partners, learners are able to advance their ides through participation and contribution to the activity. Rogoff (1994) explains learning as "the process of participation itself, arguing that how people develop is a function of their transforming roles and understanding in the activities in which they participate" (p. 209). According to Vygotsky, the best way to do this is through guided participation, in which the tutor engages the learner in joint activities, offering the learner not only instruction but also direct involvement in the learning process. Rogoff (1990) notes that Vygotsky did not recognise how much learners affect the context of their own development by choosing their own mentors, activities and settings for learning, or sometimes, by refusing the guided assistance of others when learning new skills.

Socio-cultural theory in the classroom

Socio-cultural theory is changing the nature of classroom education today as teachers are recognising that the most effective methods of instruction take into account the values, practices, and interests of the student's particular culture (Berger, 1998). "The richer, more meaningful and more active children's participation is in diverse activities, the greater the repertoire of social and cognitive skills they will develop" (Smith, 1998, p. 227). The application of socio-cultural theoretical principles is evident in a variety of ways in many contemporary classrooms.

One of the key tenets of socio-cultural theory, that of collaboration in the learning process, is applied in classrooms where teachers implement cooperative learning activities and use structured peer groups with students working to achieve a common goal. Success is dependent on group cooperative skills and the extent to which members achieve intersubjectivity through resolving differences of opinion, sharing responsibility, and engaging in cooperative dialogue.

Researchers have investigated ways of engaging teachers and students in joint activity in classrooms, for example the use of teacher modelling through think-alouds (Duffy, Roehler,

Meloth, Vavrus & Book, 1986). Palincsar and Brown (1984) designed an intervention called reciprocal teaching to assist students who were very poor comprehenders, but adequate decoders of text. In order to engage readers in constructing the meaning of a text, and to allow teachers to monitor the sense they were making of it, teachers and students used discussion structured with four strategies – predicting, questioning, summarising, and clarifying. The teachers modelled the strategies explicitly, gradually ceding control of the strategies to the children who took turns to lead the discussion. Research has proven the success of reciprocal teaching in a variety of ways. In addition to advancing the children's comprehension skills, there was an enhancement of the quality of the interactions between teachers and children, amongst the children themselves, and the nature of the learning that occurred. Gains were found to be greatest amongst those children whose teachers were adept at scaffolding the children's contributions to the discussions (Palincsar, 1998).

The use of project work in the classroom is consistent with Vygotsky's ideas about learning needing to be culturally relevant and meaningful to children. Project work allows real-life problem solving among peers. Topics differ from thematic studies or topics and are selected on the basis of academic curiosity, a social concern, or serendipitous events that direct the attention of teachers and students. Successful projects generate sufficient interest and uncertainty to provoke children's creative thinking and problem solving and are open to different avenues of exploration. Small groups of children with varying abilities and interests may work together on projects. While some teacher provocations are anticipated, projects often move in unanticipated directions as a result of problems children identify.

Teachers who are sensitively attuned to the learner's continually shifting abilities and motivation will encourage them on to new levels of competence by advancing them to the upper level of their zone of proximal development. This may be achieved through scaffolding, with teachers or more competent peers supporting an individual's learning by sharing some of the cognitive workload and guiding cognitive activity during problem solving. In the contemporary classroom it may involve guiding children in problem and goal identification, forward planning, revising, evaluating and checking outcomes, cueing, modelling, demonstrating, and questioning. Adult guidance enables a child's attention to be directed to a narrow range of features and alternatives within the task.

According to Brophy (1992), early in the process the teacher assumes most of the responsibility for structuring and managing learning activities, and provides students with a great deal of information, explanation, modelling and cueing. As students develop expertise, they can begin regulating their own learning by asking questions and working in increasingly

complex applications with increasing degrees of autonomy. The teacher still provides task simplification, coaching, and other scaffolding needed to assist students with the challenges they are not yet ready to handle on their own. This assistance is gradually reduced in response to increases in student readiness to engage in self-regulated learning.

Effective scaffolding components include opportunities for children to engage in joint problem solving in interesting, culturally meaningful collaborative problem solving activity. Through the use of discussion and debate, children can achieve intersubjectivity, a process whereby those who begin a task with different understandings arrive at shared understanding. Tasks should be structured so that the demands on the child are appropriately challenging. The amount of adult intervention should be constantly adjusted to the child's current needs and abilities. Self-regulation is fostered by allowing the child to regulate joint activity as much as possible. This requires the adult to relinquish control and assistance as soon as the child can work independently. The child should be allowed to grapple with questions and problems with teacher intervention when the child is unable to progress further.

Sergiovanni (1994) promotes the importance of authentic learning and the provision of "cognitive apprenticeships". Students learn best when actively engaged in real problem solving in authentic contexts. This is not a new idea. Over 100 years ago, Dewey argued that engaging children in authentic learning experiences and projects was more facilitative of learning than giving them isolated problems to solve. Effective learning settings allow for learners to use shared knowledge to solve problems, to practice their skills in real life settings, and for the integration of abstract and practical learning activities. "These are the conditions that increase the likelihood that teaching will be for understanding and that students will indeed be learning" (Sergiovanni, 1994, p. 192).

Linguistic perspectives

Several new approaches to classroom learning are based on the analysis of language and language practices of the classroom. These approaches demonstrate the ways in which language works to create the knowledge and meanings that constitute the way the curriculum is experienced. The language of the classroom also works to structure the social relationships that develop bewteen teachers and students and students and their peers. Research conducted from a linguistive perspective provides evidence that language is not a neutral or transparent medium for transferring preordained knowledge from teacher to student. Classrooms are regarded as language communities that develop their own forms of language. Nuthall (1997) asserts that curriculum knowledge, and the conditions for thinking about experience and acquiring knowledge are created in the process of using language. "Because of this the

structures of language become the structures through which we think, and the ways we acquire language are the ways we acquire all forms of knowledge" (p.10).

The primacy of discourse is illustrated by Palincsar (1998): "From a social constructivist perspective, discourse is the primary symbolic, mediational tool for cognitive development" (p. 361). In common with Vygotsky, Bakhtin (1981) stated: As a living, socio-ideological thing, language for the individual consciousness lies on the borderline between oneself and the other" (p. 293). Of particular interest to social scientists is the use of discourse analysis. According to Wetherell (1999) the aim of discourse analysis is to examine the larger patterning of thoughts that structures language use and the way that the meaning of language is created, reproduced, and interpreted by those who use it. From a post-structuralist theoretical position, there is more to language than just the underlying system of linguistic rules for its use. This is not a new concept. Barthes (1957) argued that to understand what this something 'more' might be, it was necessary to reconstruct the underlying relations that determine the use of particular words and phrases in particular contexts.

Weatherell (1999) points out that discourse is structured according to the existing power relations within a given society. These include the social or institutional contexts from where they emerge, the social authority of those who create and use them, and the boundaries placed around particular issues. From the point of view of classroom based research, discourse analysis can provide a valuable means of examining how the language used by teachers and students can influence the ways in which individual students experience the learning processes, and their social positioning and status within the classroom.

The use of cognitive constructivist, socio-cultural and linguistive perspectives as a frame for informing my own research

The use of a constructivist frame is particularly relevant to my interest in examining the classroom in relation to both teacher practice, and the way that individual students experience the classroom when engaged in individual and group tasks. All of the teachers in our studies described their practice and philosophy of teaching as essentially constructivist. The extent to which their stated philosophy was evident in their classroom practice is a focus of my analysis.

Of the four factors identified by Piaget that contribute to children's intellectual development, 'experience' and 'social transmission' are considered to be particularly relevant to the analysis of my own data, which focuses on the ways in which individual students experience

activities and on the significance of classroom discourse on student participation and experience.

Consistent with Vygotsky, Piaget acknowledges the need for students to engage and communicate in collaborative group activities. Social collaboration in a group context assists children in developing a critical frame of mind while also fostering communication skills. Piaget argues that such factors are essential in intellectual development. Group work is a feature of many New Zealand classrooms. Teachers in our studies were observed to plan and implement a significant number of group tasks and activities. The functioning of groups and the extent to which individual students participated within group tasks is examined in my own study. In addition, students were interviewed in-depth about their individual experience of group tasks.

Piaget's comments in relation to teacher planning and pacing of tasks in ways that provide opportunities for students to be active participants and co-constructors of knowledge have particular relevance to my own research interests. My own observations, interviews and analyses examined the ways teachers planned, implemented, and managed tasks, including the pacing of instruction and the extent to which students were able to be active participants in the learning process.

Piaget's advice in relation to the need for teachers to question children individually in order to better understand how children's thinking may differ from their own, or that of their peers, is particularly relevant to my own analysis of the types of questions asked by both teachers and students during the instructional and activity phases of lessons. In addition, extensive interviews were conducted with each subject to determine the extent to which they understood task instructions, and the depth of their concept knowledge.

In discussing Piaget's contribution to our understanding of children's intellectual development, Elkind (1974) stated:

> It is probably fair to say that the work of Jean Piaget has revolutionised our ways of thinking about the mental growth of children. We now recognise that children not only have fewer ideas than adults, but also that the ideas which they do have are different in kind from those held by grown-ups (p. 3).

The differences between students' and teachers' perceptions of the teaching and learning processes are illustrated in my analyses.

Piaget (1964) posed a number of questions to delegates at the Conference on Cognitive Studies and Curriculum development, three of which have particular relevance to my own study.

1. When a teacher appears to have successfully taught an operational structure, is the learning lasting? What remains 2 weeks or a month later? For Piaget, if a structure develops spontaneously, once it has reached a state of equilibrium it is lasting and will continue throughout the child's entire life. He questions whether learning that has been achieved by external reinforcement will be as lasting.

2. How much generalisation is possible? When you have brought about some learning, you can ask whether this is an isolated piece in the midst of a child's mental life, or if it is really a dynamic structure which can lead to generalisations.

3. In the case of each learning experience, what was the operational level of the subject before the experience and what more complex structures has this learning succeeded in achieving? We must look at each specific learning experience from the point of view of the spontaneous operations which were present at the outset and the operational level which has been achieved after the learning experience (p. 17-18).

These questions are explored in my study through the use of written pre and post-tests and extensive interviews to determine each student's concept knowledge, the extent to which they were able to recall how they learned selected concepts, and their ability to apply their knowledge.

The extent to which the teachers in the Project on Learning studies applied sociocultural theoretical principles in their classroom practice is examined. In particular, the use of collaborative tasks (as previously discussed in relation to group tasks) and the extent to which the teacher scaffolded the children's learning through task planning, management, and classroom discourse is analysed. Opportunities for students to engage in authentic problem solving tasks, and to undertake project work based on their own questions, is a focus of my research.

In relation specifically to linguistic perspectives, my own research examines the naturally occurring discourse of the classroom in instructional and social contexts. In particular, I focus on the teacher's use of language for instructional purposes, the types of content and non-

content task related questions asked by the teacher and students, and the task and non-task related interactions that occur amongst peers. The effects of the language used in the classroom is examined in relation to a variety of issues, for example accessibility to information, opportunities for participation, and social status.

In summary, the cognitive constructivist, socio-cultural, and linguistic perspectives are considered to provide a complimentary and comprehensive theoretical framework for my research which focuses on the realities of student experience and the learning that results from that experience. Expanding on Vygotsky's work, Wertsch (1991; 1998) argues that learning is a multidimensional activity, and that in order to understand the learning processes, researchers must consider all aspects of the experience, including the context, activity settings, and the participants. Nuthall (2001) concurs with Wertsch when he states:

> Teaching and teacher managed classroom activities follow very predictable patterns that are only indirectly related to student learning. This is because teachers are very largely cut off from information about what students are learning... Students live in a different world from teachers and testers and researchers. If we are to understand how teaching relates to learning, then we have to begin at the closest point to that learning, and that is student experience (p.18).

The cognitive constructivist, socio-cultural and linguistic perspectives all acknowledge the need for learners to be active in the learning process. The extent to which they can do so is largely dependent on the teacher to provide a culture of learning that encourages collaboration among all members of the classroom community. The tasks that teachers provide determine the opportunities available to students to be active in the co-construction of knowledge and to participate in the discourse of the classroom. These key factors in the learning process provide the basis of the remaining four sections of the chapter that review empirical literature in relation to the following themes: teacher centrality; classroom culture; classroom tasks and activities, and classroom discourse.

Teacher centrality

In this section of the literature review, the central role of the teacher in the classroom is examined and different roles taken by teachers in the classroom are identified. This is followed by a discussion of the impact on teachers' practice resulting from significant changes that have occurred in curriculum, and as a result of the move away from a traditional transmission model of teaching to a constructivist model of teaching and learning. The factors that influence teacher decision making in the classroom are then considered. The section concludes with a discussion of the on-going challenges faced by teachers in contemporary classrooms.

The central role of the teacher in the classroom

A central proposition of this thesis is that in the complex endeavour of teaching, the teacher is the key variable in determining how students experience the classroom. As stated by Tomic (1994):

> Teachers are the crucial factor in increasing knowledge, skills and insights, both in the cognitive and the affective domains. They have a central position in the classroom learning process, play a directive and active role and decide the daily classroom routine (p.9).

Marzano and Marzano (2003) elaborate on Tomik (1994), stating the research has shown teachers' actions in their classrooms have twice the impact on student achievement as do school policies regarding curriculum, assessment, staff collegiality, and community involvement. Hattie (2003) identified the teacher as one of six major sources of variance in student achievement. According to Hattie students account for about 50% of the variance of achievement, that is, what the student brings to the classroom. The home and peer effects each account for approximately 10% of the variance. Schools barely make a difference, accounting for 5-10% of the variance. Hattie acknowledges the importance of the schools' finances, their size, and the buildings as they have to be there to exist, but that is all. Principals are already accounted for in the variance attributed to schools, mainly because of their influence on the climate of the school. Most importantly, Hattie found the teachers account for 30% of the variance in student achievement. As teachers have no control over what the student brings to the classroom, it is their classroom practice which becomes a crucial variable. Hattie concludes that it is what teachers know and do which is very powerful in the learning equation.

Just as individual students bring a vast range of individual experiences and characteristics that impact on their learning and the way they experience the classroom, the way in which individual teachers practice teaching is similarly individual. It is possible to observe a wide variety of teaching practice in contemporary New Zealand classrooms, ranging from the teacher-directed exposition model at one end of the continuum, to transactional or 'open learning' largely initiated and managed by students. McGee (2001) describes the uniqueness of an individual classroom as follows:

> When we open the classroom door, what we see is that classrooms may be very similar in architectural design, but when the students and teacher arrive, each classroom is transformed into a unique place. Each has its own culture, its own mores, habits, and ways of interacting...Each has its own version of rules, routines, and regulations...teachers are faced with the day-to-day reality of deciding how to fit together the official curriculum, their own knowledge, beliefs and practices, and their students' learning needs. It is inside the classroom that inert curriculum

> documents have life breathed into them (p.12)...Each teacher is a complex mix of characteristics, beliefs and attitudes, generally; on top of this is what they think about teaching and learning and how they act out these beliefs and views in their work as a teacher. Their own upbringing and their own teacher education will have shaped them (p.13).

McGee's description not only illustrates the individual nature of classrooms, it also demonstrates the complex nature of teaching. As stated by Marano (1998) "We hold teaching to be a complex human endeavour requiring high-level thinking, decision making, and the capacity to form, consider, and weight multiple alternatives" (p.429). The complexity is compounded by the fact that teachers no longer work in stable contexts. According to Niemi (1999), teachers are confronting a "moving horizon" in which changing societal values, family conditions, educational and professional structures, national and global crises, and technological advances are realities in classrooms (p. 778).

Changes in teacher roles

Prior to the changes that have occurred in education over the past three to four decades, it may be argued that in general the teacher's classroom role was more fixed and uniform than the roles taken by contemporary classroom teachers. Sergiovanni (1994) identifies four different roles now taken by teachers. These include teachers as managers, executives, mediators, and leaders. Teachers as managers execute fairly specific teaching steps according to well-defined and structured protocols. When this role dominates, teaching begins to resemble a 'pipeline' with the teacher managing the flow of information. This more traditional style of teaching can be effective for teaching basic skills but is inadequate for teaching higher-order thinking skills, teaching for understanding, and encouraging mastery of generative knowledge.

When the teacher takes the role of executive, the teacher uses research on teaching and principles of learning to make proper decisions in the light of situations, but within a fairly set framework for teachers. The teacher defines the objectives for the students who are objects of the teaching rather than partners. The role of teacher as mediator is more consistent with constructivist principles of teaching and learning. As mediator, the teacher uses reciprocal teaching strategies that enable students to process new information and new learning in light of their own personal meanings, experiences, and prior learning.

The role of teacher as leader is considered to be the most important of the four with the role of the teacher to instil in students a love for, commitment to, and appreciation of learning that carries them through their school years and throughout their lives.

In another analysis McGee and Fraser (1994) describe three types of teachers and the effect of their teaching on children's behaviour and the classroom environment. The first type of teacher has ownership and control of the classroom. They are the central figures and hold the power. These teachers are likely to have a strong personality and their instructional style is to dictate, tell, and instruct. Students in their class are likely to be passive thinkers, compliant, fearful of making mistakes, with limited ownership of work. The classroom environment will be structured, sometimes rigid, often visually unstimulating, with specific, observable outcomes.

The second type of teacher shares ownership of the classroom with their students. The role of the teacher is to facilitate learning through negotiation and challenging individual learners. The teacher cares for the 'whole child', is empathetic, relates well to individual students and negotiates with them. Self-assessment is encouraged and discussion is used frequently. Students in this type of classroom are likely to demonstrate independence, tolerance of others, are co-operative, prepared to take risks, and have high self-esteem. The classroom environment reflects children's work and is visually stimulating and varied. The classroom is organised in a user friendly way with seating for groups and individuals.

The third type of teacher believes in child ownership. The teacher demonstrates trust and gives control away, is casual, provides little guidance, issues few reprimands, and tolerates differences. Students may produce few results, tend to be less self-disciplined and may demonstrate a lack of respect and irresponsibility. Selfishness may be encouraged and some personalities may dominate. The environment can be fun, chaotic, disorganised, cluttered, and even dangerous. There is no clear learning direction evident.

These two analyses illustrate the varieties of teacher approaches to learning in their classrooms. The complexity is no doubt compounded by the myriads of teachers who could be classified as falling between the styles delineated.

Significant Factors in Shaping Teacher Practice

When considering the factors that have contributed to shaping the individual practice of teachers in New Zealand, and the roles they choose to take in the classroom, it is important to note the significance of previous 'cultures' of teaching and to trace the significant changes that have occurred in the last 50 years, particularly in relation to the curriculum and new ways of thinking about teaching and learning.

The impact of previous cultures of teaching on current practice is prominent in the literature. According to Nuthall (1999):

> Teaching is an art. Wherever it is performed in the classroom it is a unique creation arising from the interactions of the teacher and students through their individual motives, interests, abilities, and previous experiences. Teaching is perhaps the most enduring and pervasive of all human creative endeavours. However, it also occurs within enduring cultural structures and conforms to enduring social practices. Like all highly developed art, teaching has established traditions and it depends for its successful performance on a background of expert knowledge. For teachers to manage or facilitate the process effectively, they must have a background of expert knowledge about how the beliefs, attitudes, and skills of students are influenced and shaped by their educational experiences (p.141).

Nuthall (2001) argues that enduring cultural practices and traditions sustain much current classroom practice. After forty years of conducting research on teaching and learning in classrooms, Nuthall concluded that much of what is done in schools is a matter of cultural tradition rather than evidence-based practice, and that much of what is believed about teaching is a matter of folk-lore rather than research. Nuthall's findings can be compared to those of McNair (1978). McNair's study involved interviews with teachers and observations of their classroom practice. McNair described the teachers in the study as "strong and unique individuals" whose personalities stood out clearly during the interviews. As they taught, however, McNair gained the impression that their thoughts were constrained in many ways by the normative activity of the public school. McNair concluded the following:

> The currents of society are powerful and within them the tides of schooling ebb and flow. The individual intelligence played its role as adjustor and monitored the eddies and swirls that occurred. Rarely is the flow disrupted and new currents developed by the participants (p.42).

Almost thirty years later, Nuthall's (2001) concern is that due to the large numbers of students that teachers have to manage simultaneously, and because of the individuality of student learning, teachers continue to rely on routines and rituals they believe are good for students. Nuthall cites the example of teachers using a brainstorming session to determine what students know. Due to the limitations of only a few students participating, often contributing what they have previously learned from self-created activities, the teacher comes away with a false impression of the role he or she played in the students' learning. Nuthall warns of the consequences of adhering to such routines:

> However, so long as these routines and rituals are recognized by the profession and society at large has the right way to run classrooms, and students have learned to play the reciprocal roles that these routines require, then teachers do not have to pay more than passing attention to what is going on in the students' minds (p.19).

The effects of previous views of teaching and learning, particularly on the development and implementation of curriculum, is also acknowledged by McGee (2001) who suggests that

centuries of influence have helped shape our contemporary views about curriculum, teaching and learning. While it is the teacher who is the ultimate curriculum decision maker, teachers do not work in a vacuum.

Changes in curriculum

One of the most significant influences on contemporary classroom practice in New Zealand was the development and implementation of the national curriculum in the 1990's. Since the 1950's, teachers had enjoyed the comparative freedom offered by open ended syllabuses. This changed substantially with the introduction of the New Zealand Curriculum Framework document in 1993. The New Zealand Curriculum Framework document comprises a set of national curriculum statements that define the learning principles and objectives that all New Zealand schools are required to follow. The document places the responsibility on teachers for ensuring the required principles are embodied in their classroom programmes.

While the New Zealand Curriculum Framework document sets out what is expected of teachers, teachers do not always understand the processes involved in teaching aspects of the curriculum. Reporting on a survey of the teaching of social studies in New Zealand, Barr (1993) states "While educators in social studies education endorse critical thinking, it can be argued that their understanding of the processes involved is not clear" (p.17). In a later research project on the teaching and assessment of skills in social studies programmes conducted in Auckland in 1996, Whitehead (1997) reported that teachers felt that a curriculum statement alone did not provide sufficient guidance in the teaching and assessment of skills. The survey made several recommendations regarding professional development, noting that professional growth must be an integral part of a teacher's role.

Discussing the development of the national curriculum, McGee (1997) noted the trend towards more detailed specifications of achievement objectives, organisation of content into levels of expected standards of achievement, and assessment strategies to check on learning. Terms like "inputs", "outputs", "productivity", and "efficiency" were reasserted. When language such as "outcomes" starts to pervade education, the teacher's role becomes that of a producer increasingly focused on compliance and with their professional knowledge subjugated to the market demands of the consumer (Gallego, Hollingsworth & Whitenack, 2001; Lingard, 2001).

McGee also noted the growing tension between central and school-based authorities over the control of the curriculum. While the central authorities appeared to have a firm hold, McGee

warned them of the need to remember that they are still dependent on teachers to implement the curriculum and in that sense, "teachers hold the ultimate power" (p.66). Four years later McGee (2001) asserted that teachers' decision-making has been re-defined with the new common curriculum that has "narrowly-specified objectives and zealous assessment" (p.9).

Another subtle, but significant change in terminology occurred when the term "children" was replaced with "learners". Ballard (2004) argues that use of the term "learner" is problematic as it is meant to distance the teacher from emotions and to construct the work of teaching as product-orientated. Ballard differentiates between the two terms by suggesting that the term "learner" causes teachers to focus on the more utilitarian aspects of what a child does which limits the teacher-child relationship. In contrast, to focus on the child involves a wider concern for the unique, individual person.

> The term "children" communicates a different sense of the teacher and child relationship in which learning is a key purpose but is undertaken within a commitment to care for and about children. Caring for children, which includes caring about their learning, is a greater professional task than responsibility for outcomes (p.22).

Changes in ways of thinking about teaching and learning

Another significant change to occur in education, particularly in the last two decades, has been in the way teachers think about teaching. As our knowledge of the learning process has developed, there has been a move away from a traditional transmission model of teaching to a constructivist model where the emphasis is on learners taking an active role and responsibility in the learning process. Changing from a traditional transmission model of teaching to a constructivist model presents a significant challenge to New Zealand teachers in that the introduction of the national curriculum has resulted in additional tensions for teachers in relation to teaching according to their own learner-centred philosophy, and the need for compliance with the demands of the highly prescribed national curriculum with its emphasis on achievement outcomes and assessment.

Teaching in a manner that integrates concerns about both learners' experiences of school and rich content learning as the outcome of schooling is described by Darling-Hammond (1996) as a "devilishly difficult dialectic" (p. 9). Teachers and administrators need to develop settings that are both "learning- centered" where the focus is on curriculum goals which challenge all students, and "learner-centered" which take into account the needs of individual students. Darling- Hammond asserts that by trying to be more child centered, the teacher may let go of teacher influence and core curriculum goals. Alternatively by trying to be more

subject-centered, students are at risk of being ignored "while the curriculum marches on ahead" (p. 9).

Niemi (1999) regards teachers as being in a problematic position. Not only is there conflict between how teachers believe they should teach, and compliance with the demands of the curriculum, teachers may want to apply active learning methods consistent with constructivist pedagogy but do not feel they have the time and energy, or in many cases, the prerequisite skills and knowledge to implement them. Niemi asserts that the professional culture of teaching originated in earlier teacher generations. While the contemporary teaching culture contains much common wisdom, it also sustains many irrelevant practices which do not support students' development into active learners. One of the problems is a lack of knowledge and a lack of meta-knowledge at all levels of the educational system. Niemi argues that students are so used to receiving ready-made task settings and orders from outside their learning that they lack both the meta-knowledge of learning and the meta-cognitive strategies necessary to be self-directed learners.

Niemi's views are consistent with those of Wade (1995) who argues that there is a natural discomfort for most teachers in allowing students some say in what happens in their school day, even for teachers who are aware of the value of doing so. Cooper (1996) asserts that while teachers possess craft knowledge (the knowledge that underpins what teachers see as successful classroom teaching), the culture of teaching and the nature of schools are such that this knowledge is often not articulated. "The working lives of teachers are dominated by the demand to perform effectively, with precious little space for reflection and consultation with colleagues" (p.76).

Promoting active learning in classrooms has had a clear influence on teachers' roles (Grimmett, 1994). Case studies from different countries in the OECD Active Learning Project (Stern & Huber, 1997) showed that teachers who wanted their students to become active learners had a new pedagogical role. They became facilitators who gave more responsibility to their students. Regarding their role as partners in a learning team, they were more democratic, negotiating aims, methods and control of learning with their students. Learners were regarded as resources for each other. New teaching methods incorporating more open tasks and projects allowed for greater collaboration between students. The teacher's position was no longer at the front or centre of the classroom, but was that of a circulating expert, learning together with his/her students and trying to give them as much space as possible (Niemi, 2002).

Teachers and decision-making

As demonstrated in the previous discussion, the decisions that a teacher makes in relation to classroom practice will be influenced by a range of factors including previous cultural practices, the impact of how they were taught as students and trained as teachers, and the demands of the curriculum. What is clear is that as the central person in the classroom, the teacher is continually engaged in complex decision-making processes. According to Eggleston (1979) decision-making is the central feature of the role of the teacher. Teachers are constantly involved in making decisions about lesson content, teaching style, motivation of students, rewards and consequences, resources and pacing of lessons. The decisions teachers make involve fine judgements of an individual learner's needs, capacities and evaluation of their achievements. Such decisions may have vital consequences for the success or failure not only of the particular lesson in which they were made, but also on the teacher and students' work in the following weeks and months. "Decisions may even call for consideration of such fundamental matters as the purpose of education and the justification of the whole raison d'etre of the classroom" (p. 1).

Many of the decisions a teacher must make during the course of the day have to be made quickly. Teachers must be able to deal in instructionally appropriate ways with the constant stream of surprises they know they will encounter. According to Cambourne (2000), not only is there a need for teachers to make spontaneous decisions "on the run" with only microseconds to shape their responses to students' behaviour, they then have to transform these decisions into some kind of action that supports and extends learning.

In addition to the inherited 'cultures of teaching' and the demands of the national curriculum, there is a wide range of situational factors that affect teachers' curriculum decisions. These factors all contribute to the complexity of teaching and the central role of teacher decision-making in the classroom. McGee (1997) classifies these factors into two categories – internal and external. External factors include social, economic and political changes; educational theories and philosophy; education system requirements; changing curriculum content; interest and pressure groups; teacher development systems, and resources. Internal factors include school environment, philosophy, culture, values and organisation; interest and pressure groups; teacher development systems and resources; community views; the teacher's own philosophy, subject knowledge, teaching style, skills, and education, and students' backgrounds, interests and abilities.

The literature shows that teachers' theories and beliefs have strong implications for the way they practice teaching (Hashweh, 1996; Zohar, Degani & Vaaknin, 2001). For example, in a

study of 40 Israeli teachers' beliefs regarding low-achieving students and instruction of higher order thinking, Zohar et al. (2001) found that 45% of the teachers believed that higher-order thinking was inappropriate for low achieving students. Findings suggest that teachers' beliefs in this context are related to their general theory of instruction: viewing learning as hierarchical in terms of students' academic level was found to be related to a traditional view of learning, that is, seeing learning as progressing from simple, lower order cognitive skills to more complex ones. The consequences of teachers' beliefs in this context may result in a self-fulfilling prophecy with low-achieving students being denied opportunities of participating in tasks requiring higher-order thinking so crucial to their development.

The effect of teacher expectations on their classroom practice is prominent in the literature. According to Saphier and Gower (1997):

> Classrooms are dynamic and complex societies that are rife with expectations: expectations that teachers have for students and the students have for teachers and for each other. These expectations explain a good deal of what we see in classrooms – the good and the bad, the productive and the wasteful. But the expectations themselves can't be seen. They hang in the air almost like anatmosphere; they exist only between people and comprise a part of their relationship (p. 295).

Saphier and Gower warn that expectations for students can turn into self-fulfilling prophesies. Ramsay (1993) discusses the need for teachers to have high but realistic expectations of children. The need to encourage children to perform at the best level of which they are capable is acknowledged. However, Ramsay warns that placing unrealistic expectations on children can do as much harm as low expectations. Teachers need to ensure that the expectations they set for children are based on their clear understanding of what is realistic for them to achieve in the classroom.

In the "Quality Teaching for Diverse Students in Schooling: Best Evidence Synthesis", Alton-Lee (2003) found teacher expectations to vary by student ethnicity, disability, gender, and other characterisitics not related to a student's actual capability. "Even when teachers are focussed on student learning, inappropriate teacher expectations can undermine students, or constitute a barrier to effective practice" (p. 16). Alton-Lee also cites studies conducted in New Zealand that demonstrate that mainstream teachers hold inappropriately low expectations for, and make inappropriate assessments of the capability of Maori students, and students with Down Syndrome.

In identifying the relationship between teachers' decisions and actions and student achievement, Brophy and Good's (1986) meta-analysis of 200 studies identified the following

aspects of teachers' practice that contribute to successful achievement outcomes for students. Teachers should:

- carefully structure activities so that students are presented with features such as advance organizers, links, analogies, overviews, outlines and reviews;
- repeat main points regularly;
- have clear questioning and presentation;
- be enthusiastic;
- match the level of questioning with the activity;
- use wait time after asking a question;
- call upon a variety of students to answer questions; provide positive but accurate feedback about students to answer questions;
- incorporate students' comments and questions into the lesson.

With the move to a constructivist view of learning, and a greater emphasis on the needs of the individual learner, a reduction in whole class methods of teaching is advocated. Cambourne (2000) argues that "those classrooms we call balanced are much too complex to be orchestrated and maintained by teachers who are armed only with a mandated, one-size-fits-all set of teaching strategies, activities, or tips" (p. 514).

On-going challenges for teachers

Teachers who wish to empower students in the classroom must engage in thoughtful soul-searching about their willingness to share decision-making and encourage initiative. According to Windschitl (1999), teachers must question whether their role is to dispense knowledge or to nurture independent thinkers; whether they are there to also learn from the students, and how they demonstrate their respect for their students' ideas. Windschitl warns that shifting centres of authority and activity in accordance with a constructivist culture demands persistence on the part of teachers. Due to their feelings of an apparent lack of control when handing over increasing authority to students, or as a result of external pressures from those who hold with traditional forms of teaching, some teachers reconsider their ideas of student-centred learning in favour of conforming to traditional forms of teaching where the teacher is the centre of classroom discourse and attention.

The dilemma some teachers find themselves in is evident in Day and Leitch's (2001) study. The teachers who were interviewed identified both positive and negative aspects of educational reform. They highlighted the courage required by teachers to "maintain their roles in mediating knowledge rather than acting as sub-contractors who simply implement

externally imposed policies" (p. 409). When asked about the interaction between personal biography and professional and social contexts upon teachers and schools one of the subjects responded:

> I once heard my job described as an ant on a patterned carpet. You are so wrapped up in either teaching or administration you never find the time to step back and really effectively assess how the staff and school are doing. You know there is a pattern somewhere but you are so close to it you can't see it properly (p. 408).

Day and Leitch (2001) conclude that "Teaching at its best requires motivation, commitment, and emotional attachment, and this requires a deep knowledge of self as well as student" (p. 414).

A real challenge for teachers is being able to work within the constraints of school structures, particularly those related to time and the crowded curriculum. There is much evidence in the literature to suggest that many teachers feel frustrated by the amount they are expected to cover in the curriculum, and that they do so at the expense of student understanding. This contention is supported by Brandt (1993) who contends that coverage is "the greatest enemy of understanding" (p. 7). Teachers who try to cover everything do so at the expense of their students' understanding. Brandt urges teachers to take time to get children deeply involved in something so that they can think about and apply it in different ways both within and outside the school context.

Planning what to teach in order to best meet the needs of individual learners is another on-going challenge for teachers. Studies of teacher planning and decision-making in the 1970's, showed that teachers considered alternative strategies only when the instructional process was judged to be going poorly rather than as a way to optimise instruction. The primary cue used by teachers in judging how well the instructional process was going was student participation and involvement. However, even when instruction was going poorly teachers rarely changed their strategy from what had been planned (Clark & Yinger, 1977). Teachers spent the largest proportion of their planning on the subject matter to be taught. After subject matter, teachers concentrated their planning on instructional processes (strategies and activities); and the smallest proportion of their time was spent on objectives (Zahorik, 1970; Clark & Yinger, 1977). Morine (1976) found teachers to be fairly specific and use an outline form in their plans yet paid little attention to behavioural goals, diagnosis of student needs, evaluation procedures, and alternative courses of action.

In more recent studies, Alton-Lee and Nuthall (1998) emphasised the need to organise and timetable the teaching of the instructional units to ensure dense and recurrent assess to

relevant content. They suggest the use of inter-linked classroom activities to support the developmental sequence of construct generation and thus optimise learning opportunities for all students.

Philips, McNaughton and McDonald (2001) argue the need for teachers to plan opportunities for children to learn through joint activity or the co-construction of meaning through classroom tasks. They advocate the use of different instructional activities and forms of guidance as an integrated whole, changing and adjusting them as required to suit individual needs of the students.

Alton-Lee (2003) concludes that the teacher's approach to planning, organising and sequencing tasks can play a key role in promoting learning orientations and learning community. In order to facilitate long-term learning, teachers must plan curriculum appropriate opportunities that allow students to practice and apply their new learning in authentic, relevant contexts. Alton-Lee argues that this type of planning can result in sustained impacts on student knowledge, attitudes, self-esteem, independence and confidence.

Lack of time for teachers to reflect and evaluate teaching programmes is also prominent in the literature. Donoahue (1994) conducted an investigation into one teacher's journey into classroom inquiry about science teaching and science writing. Discussing the rationale for conducting the investigation, Donoahue noted that she was aware when things weren't going well in her classroom causing her to feel stressed. She also knew that she could improve her teaching and alleviate her stress by taking time to reflect on her practice. Her frustration was that she never had the time for such critical reflection or to think about how to change the problem areas.

Donoahue's investigation arose from her frustration with the poor job her grade 4 students were doing with completing record sheets for a science activity. It was clear to Donoahue that the children did not see value in what they were required to do and that they were only filling out the sheets because she insisted on it. Donoahue used a number of strategies to improve the quality of the children's science report writing including written prompts, keeping activity logs, talking to the children as they wrote, and sharing of their writing with the whole class. Donoahue concluded that the benefits to teachers of engaging in classroom inquiry are significant, especially when undertaken with like minded-colleagues.

One of the key problems for classroom teachers is class size. Nuthall (2001), argues that having responsibility for a class of 25 or 35 students, all of whom have different knowledge,

skills, interests and motivations makes it impossible for a teacher to focus on the learning of an individual student for more than brief periods. Nuthall adds that no one has ever given clear empirical evidence that a teacher can possibly be responsible for the learning of 25-35 students simultaneously. Wingrad (2002) agrees that large classes mean that teachers need to standardize curriculum, reduce student movement and initiative, and "keep things quiet". As class numbers increase, so do the number of negotiative conversations with students. The result is an increase in teacher workload and a reduction in the amount of time for teachers to engage in critical analysis of their practice.

While much is written promoting the need for teachers to reflect on their practice, Nuthall (2001) argues that the problem is greater than just one of having sufficient time. Nuthall presented extensive evidence that most teachers have little understanding of what is happening in their classrooms and what their students are learning. As a result, Nuthall argues that the reflective teacher model that has come to dominate thinking about teacher education and professional development for teachers, also serves to sustain the standard routines and rituals of teaching. Nuthall's main criticism is that the model presupposes that the reflective teacher has valid information about what is happening in the classroom and what individual students are learning.

The need for changes in the way teachers view their role in the teaching-learning process is obvious. This change needs to be implemented at both pre-service and in-service levels of teacher education. Discussing current changes in teacher education programmes to constructivist pedagogies, Holt-Reynolds (2002) notes that new teachers are being asked to apply constructivist principles in their practice. This involves learning how to draw on students' existing ideas and to elicit their participation as a basis for constructing new, more reasoned, or more accurate understandings.

Niemi (2002) concurs with Holt-Reynolds, arguing the need for a change in the learning ethos in schools, and the challenge this presents to in-service teacher education and those who are responsible for curriculum planning. Niemi asserts that it is necessary to create a strong cultural change from outer-regulated learning to the real responsibility and ownership of students for learning. Promoting a continuum of in-service education for teachers, Niemi argues that "The effectiveness of teacher education depends on teachers capacities to learn new methods in their work and primarily to be ready to reassess their working culture" (p. 779).

This review demonstrates the many issues and tensions inherent in teaching. Teachers clearly want the best for their students as illustrated in the following extract from van Manen (2002):

> If teaching is indeed a caring profession then the caring involves helping, encouraging, admonishing, praising, prodding, and worrying about individual students and classes. At the end of the day, what matters to teachers is that they provide their students with positive experiences, that there was a good atmosphere in their classes, that students felt safe and successful in their learning activities, that personal difficulties could be worked out, that life was happy and good for them and their students (p. 138).

It must be asked whether it is enough to provide the kind of experiences mentioned by van Manen, or do we want more for our students and ourselves as teachers? Teachers are clearly constrained by class sizes, school structures, and the rituals and supporting myths that sustain current teaching practice. Nuthall (2001) is critical of the role research has had to play in supporting the standard routines and rituals of teaching. Citing a large body of ethnographic and empirical studies of teachers' practice, Nuthall points out that in none of the examples is there any direct reference to the learning of students. Nuthall is similarly critical of educational texts and handbooks on teaching and learning arguing that with the exception of behaviour modification, none of the theories in the textbooks is based on research on students' experiences in classrooms. According to Nuthall "We seem to have created a system in which it does not really matter if students learn or fail to learn from their classroom experiences" (p. 22). In order to improve a system that inevitably produces failure and inequalities, Nuthall challenges the research community to conduct research that focuses on the realities of student experience and the learning that results from that experience.

In summary, this section of the literature review has established the central role of the classroom teacher in the teacher – student relationship. The changing roles of teachers and the significant factors in shaping contemporary teachers' practice have been discussed. Demonstrated in the literature are the tensions teachers feel between their ability to apply teaching methods that are consistent with their stated constructivist pedagogy, and the constraints they perceive on their practice.

The extent to which this is possible is determined by the culture of the classroom that is created largely by the teacher, but in interaction with the students. The influence of classroom culture on opportunities for students to learn is discussed in the following section of the literature review.

Classroom culture

The issues relating to classroom culture are central to the main research focus of the thesis, that is, the culture that the teacher constructs within the class that does or does not create opportunities for learning. This section of the review begins by defining culture as it relates to both the wider cultures of contemporary life, and in particular, to the context of the classroom. The case is put for the need for teachers to understand the significance of culture in the classroom, followed by a discussion of some of the problems related to classroom culture that perpetuate and legitimise institutional bias and inequality. The section concludes with a review of literature that suggests ways that teachers can act as agents of positive change in developing inclusive classroom cultures.

Defining culture

The term 'culture' has been used traditionally to classify civilizations and social groups according to their customs, lifestyles, mores, and in particular, their ethnicity. Prior to the increased awareness of the significance of socio-cultural factors on teaching and learning, it is suggested that rather than developing their own cultural understandings and practices, schools and classrooms would have reflected the dominant, often fixed values and social practices of their wider societies.

The concept of culture has now broadened to reflect an increased understanding of the wider cultures of contemporary life, including an acknowledgement that culture may be manifested differently in individual classrooms and that individual students will experience that culture differently. According to McLaren (1995):

> By the term culture, we signify the set of knowledges, subjectivities, conceptions and views of the world, values and social practices that constitute a particular social space. We understand the culture of a classroom not as fixed but as shifting, contested and problematic: it will vary, perhaps considerably, over time, from day to day and even from moment to moment. Equally, each participant will experience that culture differently, reflecting each individual's identities and positioning. Thus, we seek to hold to a 'theory of culture that insinuates elements of discontinuity and indeterminacy into what is usually perceived by educational researchers as uniform and determinate' (p.38).

Inherent in McLaren's definition are both the complexities and subtleties of the impact of culture in the classroom. Educational researchers advocate the need for educators to be aware of the significance of culture in the classroom. Nuthall (2001) states:

> One of the most significant things about culture is that it becomes so much a part of ourselves that we can no longer see it for what it is. The more familiar it is, the more it is like the air we breathe, the harder it is for us to see it... So long as we are

> unaware of the extent to which culture determines how we practice and think about teaching, we will remain locked in a system that inevitably produces failures and inequalities (p. 1-2).

Nuthall's comments in relation to failures and inequalities suggest power differentials between members of the classroom community. Traditionally the teacher has held the 'power' and has been the prime determiner of classroom organisation and management. Post-structural theorising examines power relations as ongoing, dynamic interactions played out among all participants (Foucault, 1980; 1982; McLaren, 1991).

The case for understanding the significance of classroom culture is put by Nuthall (1999) when discussing the findings of his extensive classroom-based studies into teaching and learning of year 5 and Year 6 students.

> Teaching is perhaps the most pervasive of all human endeavours. However it also occurs within enduring cultural structures and conforms to enduring social practices...The data suggest that even basic knowledge acquisition involves complex cognitive processes that are strongly shaped by the social processes and cultural structures of the classroom (p. 141-142).

Allard and Cooper (2001) consider that examining classroom cultures at the micro-political level offers scope for considering how power relations can contribute positively to educational processes. They propose that individually and collectively, students and teachers act to achieve their own outcomes which may be different for individuals. Classroom cultures are not just established by formal school rules or those elaborated only by the teacher. Similarly, classroom culture does not rest solely on the teacher's management techniques or disciplinary practices established within the school. To promote quality teaching and learning outcomes, Allard and Cooper suggest it is necessary to understand how a positive classroom culture can be established through the interactions of all members of the classroom, and that teachers and students should build classroom culture together.

As promoted by Allard and Cooper (2001) classroom culture should ideally be co-constructed by teachers and students in inclusive ways that ensure individuals and groups are not marginalized or disadvantaged on the basis of their gender, ethnicity, perceived level of ability or socio-economic status. Unfortunately this is often not the case. Williams (1981) is critical of the claim of education systems that they are transmitting "knowledge or culture in an absolute, universally derived sense, when it is obvious that different systems, at different times and in different countries, transmit radically different selective versions of both" (p. 186).

Moore (2000) discusses ways in which culture may be used in education systems as a way of disguising, perpetuating and legitimising institutional bias and inequality, and of presenting a particular 'reality' in which some students are configured and perceived as more or less clever, motivated, or hard working than others. Moore suggests that such a reality is often configured in terms of 'merit' -a notion that is preferable to rewarding privilege. Such a view is not new. Michael Young coined the term 'meritocracy' in 1958. Discussing Young's (1958) analysis, Moore (2000) asserts that meritocracy leads to the early identification and special treatment of children who are considered to be "more able". Meritocracy is linked to educational practices that emphasise test scores and qualifications as ways of assessing and rewarding ability. In such systems, notions of intelligence are described as 'culture-free' or something that exists 'in itself' rather than as a social construct. As such, notions of intelligence may serve to disguise cultural bias. Achievement may be seen to be the result of deficits or advantage within an individual student, rather than the match or mismatch between the cultural preferences and preferred learning styles of the student and the school.

Nuthall (2001) agrees that differences in intelligence are likely to be the result of the way in which the culture of the classroom shapes student experience and provides additional learning opportunities for students whose cultural and learning preferences match those of the teacher. Those students whose backgrounds provide them with the cultural knowledge and skills to use the classroom and its activities for their own purposes learn more than those who dutifully do what they are told but do not want, or know how to create their own opportunities. "Differences in intelligence are more likely to be the product of differences in classroom experiences than the other way round" (p. 15).

In the education system, intelligence has traditionally been measured by pen and paper tests. Nuthall (2001) argues that the differences in what students learn, and differences in their test performance are created by differences in how they engage with classroom and testing activities. In both cases these are a function of their motivation and the extent to which they share the purposes and culture of the teacher or tester. "The fact that differences in motivation and culture are also related to differences in ethnic background and family resources, means that the myth explains failure while protecting the real causes of failure" (p. 20).

There are concerns about the way that curriculum content may serve to disadvantage academically those students who come from low socio-economic or ethnic minority groups. One of the most influential theorists in the area of cultural bias in curriculum is Pierre Bourdieu with his theory of 'habitus' and 'field' (1971). Building on Dewey's understandings of habit (Dewey, 1932), Bourdieu uses the word 'habitus' to define a person's

socially acquired yet – to the person in whom it resides – generally invisible 'disposition' (Bourdieu 1977). According to Bourdieu (1971) it is the system of modes of perception, of thinking, of appreciation and of action that humans carry with them into the full range of social milieus and the full set of circumstances within which they move and operate. The word 'field' is used by Bourdieu to describe the very real and often quantifiable social milieus and circumstances. As defined by Jenkins (1992) fields are "social arenas within which struggles or manoeuvres take place over specific resources or stakes and access to them" (p.84).

It may be argued that many of New Zealand's current educational processes perpetuate the rewarding of privilege and provide greater access to the specific resources or stakes mentioned above. Examples include assessment and reporting systems biased in favour of high achieving English speaking students, the wide use of ability streaming, availability of accelerant programmes for 'more able' students, inadequate resourcing of programmes for students with special learning and behavioural needs and those for whom English is a second language, and the prescribed nature of the national curriculum which does not always take into account the prior experiences and knowledge of minority group students. Such rewarding of privilege is consistent with the 'Matthew Effects' (Stanovich, 1986). 'Matthew Effects' occur when children who already know more about or are skilled in an area on which instruction is focused, get more benefit out of the instruction. High progress children are able to learn even more through access to a more advanced, wider range of instruction. As argued by Phillips, McNaughton and MacDonald (2001) low progress children remain with more restricted instruction and have fewer opportunities to progress to the level of their peers, "unless instruction is carefully managed it becomes a default condition of classrooms" (p. 23).

It must be acknowledged that the New Zealand Curriculum Framework (1993), the official policy for teaching, learning, and assessment in New Zealand schools, is based on principles of culturally inclusive practice. The following principles are particularly relevant to issues of culture and equality.

- The New Zealand Curriculum provides all students with equal educational opportunities. The school curriculum will recognize, respect, and respond to the educational needs, experiences, interests, and values of all students: both female and male students; students of all ethnic groups; students with different abilities and disabilities; and students of different social and religious backgrounds. Inequalities will

be recognized and addressed. All programmes will be gender-inclusive, non-racist, and non-discriminatory, to help ensure that learning opportunities are not restricted.

- The New Zealand Curriculum recognizes the significance of the Treaty of Waitangi. The school curriculum will recognize and value the unique position of Maori in New Zealand society. All students will have the opportunity to acquire some knowledge of Maori language and culture. Students will also have the opportunity to learn through te reo and tikanga Maori. The school curriculum will acknowledge the importance to all New Zealanders of both Maori and Pakeha traditions, histories, and values.

- The New Zealand Curriculum reflects the multicultural nature of New Zealand society. The school curriculum will encourage students to understand and respect the different cultures which make up New Zealand society. It will ensure that the experiences, cultural traditions, histories, and languages of all New Zealanders are recognized and valued. (p.7).

Although the current New Zealand National Curriculum is based on more culturally inclusive principles than previously, the reality is that Maori and Pacific Island students continue to leave school earlier and with fewer academic qualifications than Pakeha students. The increasingly multicultural composition of New Zealand society means many schools have large numbers of students from a range of ethnic minority groups. In 1994 over one quarter of the students in New Zealand schools were Maori (20.3%) and Pasifica (6.8%). Pacifica students comprised 8% of students in 2001. The proportion of international and Asian students has grown from 4% to almost twice that in the last decade (Alton-Lee, 2003).

Despite their best efforts, teachers cannot be expected to know and understand the home cultures of all students in their classrooms (Moore, 2000). The demand for teachers of te reo (language) and tikanga Maori (culture) exceeds supply, and the limited knowledge of the Maori language limits many teachers to paying other than tokenism when implementing te reo and tikanga Maori in their classrooms. Research has shown over the last two decades that mainstream teachers in New Zealand have inappropriately low expectations for, make inappropriate assessments of, and/or provide lower levels of praise for, Maori students in English medium New Zealand classrooms (Carkeek, Davies & Irwin, 1994; Millward, Neal, Kofoed, Parr, Luin Lai & Robinson, 2001).

In contrast, the Ministry of Education (2001) report "New Zealand Schools Nga Kura O Aotearoa: · A report on the compulsory schools sector in New Zealand 2000", provides evidence of higher achievement of Maori in Maori-medium settings rather than English or bilingual medium education at years 11 and 12 in 2000 and 2001 examination results.

While the National Curriculum Framework is based on principles of culturally inclusive practice, it is dependent on teachers to apply them. Darling-Hammond's (1997) synthesis of research on influences on student learning concluded that learning is supported when structures for caring, opportunities for collaborative learning and appreciation of diversity are established in classrooms. However, in a survey of beginning teachers in New Zealand carried out by Gray and Renwick (1998), many did not perceive reinforcing the shared values of the National Curriculum Framework to be applicable to their teaching. Less than half of first year New Zealand secondary teachers felt well prepared to reinforce caring amongst their students and 5% did not see this shared value as applicable to their teaching (Alton-Lee, 2003, p.23).

Student perceptions of what constitutes a supportive classroom culture are considered to be of particular importance. Gray and Renwick's (1998) findings are in direct contrast to studies of student perceptions of factors that help to create caring, supportive learning environments. The perception of teachers as caring individuals who create a supportive and caring learning environment features prominently in the literature. Ferreira and Bosworth (2001) examined 101 middle school students' definitions of a caring teacher. Their results indicated that when students are not actively involved in care-giving their understanding of caring and caring relationships becomes focused on self. The authors conclude that to develop an ethic of caring so that schools become true caring communities, students need opportunities to care for themselves, their surroundings, and others in their community. Pointon and Kershner (2000) assert that teachers represent the main connection between the student and the school, and have an enormous impact on how the philosophy of the school is translated and communicated to their students.

An important aspect of classroom culture is the extent to which the cultural capital of students matches that of the teacher. "There is, diffused within a social space, cultural capital, transmitted by inheritance and invested in order to be cultivated" (Bourdieu, 1971, p.201). In New Zealand the majority of teachers responsible for delivering the curriculum are white and middle-class. The cultural capital of white, middle-class students is more likely therefore to match that of their teachers. As proposed by Tizard and Hughes (1984), students from middle-class homes are far more likely to find a close match between what is expected and

valued at home and what is expected and valued at school than are students from working-class homes. As a result, the issue of 'cultural capital' may still impact the classroom and marginalise students from socio-economic and ethnic groups other than white middle class. Such marginalisation is often subtle with students being unaware that their under achievement may be due more to the limited and limiting curriculum that presents the dominant, middle-class values and perception of what constitutes 'knowledge of importance', than through their own innate ability or effort. This may in turn lead to marginalised students developing a low self-concept or to see themselves as academically and intellectually deficient and to under-perform accordingly (Moore, 2000).

One of the less subtle forms of marginalisation of students is practice that equates with "symbolic violence" (Moore, 2000, p.100). Citing the case of a student of Bangladesh origin, Moore describes how the student's alternative approach to completing a written language task based on his previous learning experiences and expertise in the replication of cultural-linguistic forms might as well not exist. His work was perceived by the teacher as a deficient way of telling a story, thus invalidating the student's own personal experience and portraying his own lived reality that shaped the content of his story as mistaken.

Moore (2000) lists several ways that teachers can operate in anti-culturist ways that may challenge some of the coercive practices and views that students might otherwise take for granted. These include: manifest institutional validation of minoritised cultures through displays and notices in a range of languages and registers; the use or development of text books and teaching resources designed to undermine the myth of linguistic and cultural 'rightness' or to counteract stereotyping related to gender, ethnicity or class; adopting individual strategies to validate students' favoured cultural forms in the classroom, ensuring that when students introduce 'alternative' viewpoints or express themselves in 'non-standard' ways these are not rejected or marginalized as wrong. In relation to the issue of symbolic violence, Moore suggests that teachers who want to counter symbolic violence need to look outwards to the deeper structures within which their practice is located, as well as looking inwards at their own classroom practice, particularly the way in which their students are assessed.

Teachers and students work together to establish particular power relations as part of the classroom culture (Manke, 1997). Researchers have also found that the students themselves develop their own peer culture, over which the teacher may have little influence. According to Alton-Lee (2003) "Peer cultures and sub-cultures can provide social and material resources

supporting and enabling individual students in their interaction with curriculum content, or they can function to hamper, exclude, isolate and humiliate individual students" (p.34).

A number of New Zealand studies have been conducted in the area of peer-culture. Alton-Lee and Nuthall (1990) found that negative social interactions between Maori and Pakeha students in a Year 7 social studies class directly interfered with their learning. Nuthall (1996) investigated the contrast in classroom peer sub-cultures in the valuing of peer ideas. A low-achieving Samoan student was the recipient of and gave abusive comments about errors, in contrast to positive comments given and received by high-achieving Pakeha students. In a further study, Alton-Lee, Nuthall & Patrick (1993) demonstrated how the cultural practice of bullying and power abuse subverts learning. Alton-Lee et al. concluded that "students need teacher modelling and explicit teaching that evidence, rather than power should be used to resolve intellectual conflict in order to genuinely assist the learning process and develop a peer learning culture".

Findings from his extensive classroom-based research projects made Nuthall (2001) realise that students live in their own personal world. How their peers evaluate their behaviour is more important to students than the teacher's judgement. "Within this pervasive peer culture, sexism and racism can be alive and flourishing even when the teacher actively promotes fully inclusive learning activities" (p. 8). This again points to the need for classroom studies that include students' lived experiences.

Teachers as agents of change

Much has been written about best practice in teaching and the benefits of teachers involving learners actively in all aspects of the learning process. While curriculum documents specify official policy for teaching and learning, the actual implementation of such policy continues to rest with individual teachers (McGee, 1997). By virtue of their continuing position of authority in the classroom, teachers can choose to be powerful agents of change both individually and collectively.

There are a number of ways teachers can foster an inclusive classroom culture. The notion of 'differentiation' is considered to be important in relation to classroom practice. Differentiation is defined by Moore (2000) as "a planned process of classroom interventions designed to maximise every student's potential and to take account of every student's individual needs at a given point in time" (p. 107).

Differentiation acknowledges the unique knowledge, skills and attitudes each student brings to school. Capel, Leask and Turner (1995) argue that it is the teacher's responsibility to ensure their planning takes into account differences in culture, expectation, knowledge and experience. In their opinion "it is the teacher's job to make the curriculum interesting, relevant and cognitively digestible" (p. 122).

Suggested modes of differentiation adopted by teachers include differentiation by outcome where the teacher sets the same task for all students but expects different outcomes; differentiation by response where the teacher varies their response to students' work according to their knowledge of each student's previous performance; differentiation by task where the teacher sets different tasks for students according to their current expertise or knowledge; and differentiation by stimulus that caters for different learning styles.

Although teachers cannot be expected to know and understand the home cultures of all students in their classrooms, Moore (2000) suggests a number of safeguards that can be integrated into classroom practice. These include recognising that all students are different and their ways of perceiving and learning are different; asking when a student does something unexpected whether it could be a cultural issue; understanding that the curriculum is selective and that other selections may be equally valid; and understanding that student failure may be the result of a range of factors that have nothing to do with ability.

Constructivism as a culture

The move towards a constructivist theory of teaching and learning, and the acceptance of Vygotskian theories about the social nature of learning, gave rise to the concept of 'communities of learners' (Rogoff, 1990). Rogoff proposed a learning community based on an apprenticeship of learning in which experts support and scaffold novices in their learning. In a community of learners, all members, students and teachers, actively engage in both learning and teaching. This involves a transformation of participation in which the roles of the members in the classroom change. This interchange of roles contrasts with models of teacher-run (dispenser of knowledge), and student-run (discovery) orientation to the instruction. A community of learners is described by Crawford, Krajcik and Marx (1999) as a dynamic learning space in which the students and teacher are equally important participantswhose roles change over the course of a project as different expertise comes into play.

The concept of learning communities is now widely promoted. According to Leinhardt (1992) learning is an active process of knowledge construction by the student. Knowledge is a cultural artifact of humans, which is distributed among group members. The distributed knowledge is greater than that possessed by an individual member. Sergiovanni (1994) considers knowledge as simultaneously owned by both individuals and the community. "An individual student's knowledge grows and is shared amongst the community of learners, contributing to the shared growth and accumulated knowledge that exists in the classroom as a whole" (p. 191).

The potential benefits of learning communities and the key role that the teacher has in their establishment and maintenance is summarised well by Alton-Lee (2003).

> ...learning communities provide environments that facilitate achievement...the peer culture has been developed by the teacher to support the learning of each member of the community. The teacher has a key role to play in creating a community that does not generate 'them' and 'us' distinctions but includes those of 'us' whatever our cultural identity, who are part of our community. Diversity is valued, addressed and integral to instructional strategies. Caring and support is integrated into pedagogy and evident in the practices of teachers and students...academic norms are strong and not subverted by social norms...A learning community is neither stymied by a 'culture of niceness' that impedes learning nor undermined by peer abuse and intimidation...There is strong evidence of the positive impact of teacher and student development of effective learning communities, not just for some learners, but across the range of diverse learners, and for heterogeneous groupings of learners (p. 31).

While it is acknowledged that schools are in the middle of a cultural change, the application of constructivist pedagogy is considered to be complex, and requires a major paradigm shift for many teachers (Saphier & Gower, 1997). The role of the teacher must change from that of dispensing knowledge, to eliciting student participation and using students' existing ideas and knowledge as a basis for helping them to construct new, more reasoned understandings (Holt-Reynolds, 2000). Pedagogies of co-construction have given rise to associated participation metaphors, for example building, reflecting, inquiring, talking, and project-centred learning. According to Holt-Reynolds (2000), these pedagogies "project a teacher who is able to use personal expertise and authority to develop classroom culture that invites and values student participation in intellectual tasks" (p.22).

Despite our new understandings of teaching and learning, and the ways in which the classroom culture can influence the way an individual student experiences the classroom, the gap between the rhetoric and the reality of creating cultures of learning based on constructivist principles appears to endure. Niemi (2002) found that while teachers may espouse constructivist philosophies, active learning and other revisions of the learning culture

are implemented by teachers and mainly with fairly closed tasks. Niemi found that teachers expressed a desire to implement open learning environments which require student initiative, planning, experimentation and evaluation, but felt that the required time, energy, and resources were obstacles to them implementing such environments.

Alton-Lee (2003) has identified the following research-based characteristics of quality teaching that have particular relevance to the development of a supportive, inclusive classroom culture.

- Teachers ensure the student experiences of instruction have known relationships to other cultural contexts in which the students have been / are socialized;
- Relevance is made transparent to students;
- Cultural practices at school are made transparent and taught;
- Ways of taking meaning from text, discourse, numbers or experiences are made explicit;
- Quality teaching builds on students' prior knowledge and experience;
- Student diversity is utilized effectively as a pedagogical resource;
- Quality teaching respects and affirms cultural identity (including gender identity) and optimises educational opportunities (vii).

In summary, this section of the review illustrates the extent to which classroom culture impacts on the teaching and learning process for individuals and groups of students. It has also identified some of the complexities for teachers in developing a classroom culture that is inclusive and supportive of all classroom members. It is imperative that teachers are aware of issues related to culture in the classroom, and the significance of the power of peer sub-cultures on the power relations of the classroom, over which teachers have little control.

It is strongly suggested that teachers do not abuse their position of power but negotiate with their students to co-construct a classroom culture based on constructivist principles of learning. For many teachers this will involve a considerable challenge to their philosophy and practice and they may require support from other professionals and colleagues as they make the required changes.

In conclusion, it is worth repeating Nuthall's (2001) warning. "So long as we are unaware of the extent to which culture determines how we practice and think, we will remain locked in a system that inevitably produces failure and inequalities" (p. 2).

As demonstrated in this section of the literature review, the culture of the classroom is determined to a large extent by the opportunities the teacher provides for students to be active participants in the learning process. As classroom tasks are the primary vehicle for transmitting curriculum content (Doyle, 1983), the following section of the literature review examines the significance of classroom tasks and activities in providing, or alternatively, limiting opportunities for students to learn.

Classroom tasks and activities

A major focus of the thesis is on the ways in which individual students participate in selected classroom tasks and activities, particularly in the curriculum areas of science and social studies. In this section the significance of classroom tasks and activities in providing opportunities for students to learn is discussed. The section begins with a definition of classroom activities, next, their significance on student learning outcomes is established. This is followed by a discussion of some key issues related to tasks and teacher decision-making. The effects of classroom tasks in relation to student interest, motivation, personal goals, and skill and ability are considered. The section concludes with the identification of a number of characteristics of effective classroom tasks.

Defining tasks and activities

The terms 'tasks' and 'activities' are used interchangeably in the literature. For the purpose of this thesis, Nuthall's (2000) definition of an activity will be used.

> A classroom activity is defined as a sub-unit within a larger curriculum unit or topic that is focused on a significant concept, understanding, principle or skill that the teacher intends the students to learn or acquire. Often such a sub-unit will revolve around a particular pattern of classroom organization such as a whole-class discussion, a small group interaction, or individual seatwork. However, most of the sub-units defined as classroom activities involve some mixture of these patterns. So, for example, a social studies activity might begin with a whole-class discussion, change to a small group research activity, and end with students working individually on a written report. What holds the activity together is the intended curriculum purpose or learning outcome (p.14).

Nuthall describes an activity as having both structure and process.

> The structure describes what is common to the sequence of behaviours that occur on different occasions and in different contexts. However, what happens on any one occasion is not an exact replica of what happened on previous occasions. There are variations, and these variations are not just incidental or accidental. The process of carrying out an activity on a particular occasion is the product of interactions between the individuals concerned: their personal characteristics, goals, and past histories. The enactment of an activity involves both the structure (the expected and predictable

sequence of tasks and behaviours) and the process (the dynamics of interactions between the individuals and their personal characteristics) (p.13).

Significance of classroom tasks and activities

One common feature of most teachers' practice is the use of tasks and activities as the primary vehicle for transmitting curriculum content (Doyle, 1983). It is estimated that the average student will be assigned approximately 20,000 tasks during their school career (Fisher & Heibert, 1990). Academic tasks have been described as "the crucible in which student motivation, student cognition, instruction, and learning fuse" (Turner, 1995, p. 415). Both teacher behaviour and the nature of tasks influence students' perceptions of the purpose and value of tasks, their understandings of the procedures to follow, and their task-specific expectations for mastery. Teacher behaviour and student cognitive processes are associated with learning outcomes through the tasks students complete (Blumenfeld & Meece, 1988).

The significance of tasks on student thinking and learning is emphasized by Mergendoller, Marchman, Mitman and Packer (1998) who assert that while classrooms are expected to be places where students think about and learn academic content, the types of thinking students engage in and the quality of learning that occurs are largely influenced by the nature of the tasks students complete. "The tasks teachers assign determine the cognitive strategies students have the opportunity to practice and the complexity of the schemas they construct" (p. 251).

Alton-Lee (2003) emphasises the key role the teacher has to play in task design. "The teacher's approach to planning, organizing and sequencing of tasks, of itself, can play a key role in promoting learning orientations and learning community" (p.26). The tasks that teachers assign to students and the ways in which teachers and students manage those tasks reflect not only the nature of teachers' individual practice, but also the uniqueness of individual classrooms and the socio-cultural factors that impact student classroom experience. According to Nuthall (1999):

> Because of the unique nature of each classroom and of the evolving socio-cultural history that determines how students respond to the actors and activities that make up the classroom, the effects of specific teaching methods or techniques can only be predicted by reference to those underlying psychological and social processes that are more or less general to all classrooms (p. 142).

Tasks and activities are used for a variety of instructional, assessment and social purposes. Three of the most significant influences of tasks are the opportunities they provide for knowledge acquisition, the extent to which they motivate learners to engage and persist with an activity, and the influence of task structure in shaping student social relationships.

The need for students to be able to engage in cognitively challenging tasks is inherent in the following caution from Fisher and Heibert (1990):

> If the majority of the 20,000 tasks that make up a school career are teacher-specified, cognitively simple, and done either by oneself or involve listening to the monologue of an adult, educators should wonder why so many students stay in school rather than wonder, as they do now, why some students drop out of school p.14).

Tasks and principles of constructivist teaching and learning

With the restructuring of the New Zealand education system under Tomorrow's Schools (1989), the notion of greater empowerment and choice for local communities and schools was intended to replace the centralised, rigid, and prescribed curriculum and administrative structures and policies. These changes were consistent with a greater awareness of teaching and learning theory based on constructivist principles, and an acknowledgement of the impact of socio-cultural factors on individual classroom experience. School staffs and Boards of Trustees expended many hours rewriting policies in areas of school management and curriculum to better reflect the identified needs of their communities.

The expenditure of such time and effort has been questioned when just a few years later, the requirements for schools appear to be changing again (McGee, 1997). There is a tension for those teachers who subscribe to constructivist learning principles and greater involvement of students in making decisions about what and how they learn, and compliance with teaching to a prescribed curriculum and complex, time-consuming assessment systems.

There is a tension also between the types of tasks that are compatible with constructivist learning principles, that is, 'open' or loosely structured tasks that allow for authentic problem solving and student autonomy, and those tasks, which are commonly assigned in classrooms. A survey of the social studies tasks undertaken by 3000 students in Western Australia indicated that the most common tasks were copying from the blackboard, reading, colouring in, and drawing pictures and diagrams (Moroz, 1998). The 1987 national survey of social studies topics in New Zealand reported "Many lessons were organized in such a way that the teacher dominated them rather than encouraging student inquiry and initiative" (New Zealand Department of Education, 1987, p.42). The current New Zealand social studies curriculum makes it clear that understandings should be constructed by learners, not prescribed by teachers. According to prominent New Zealand social studies authority Hugh Barr (1999) it appears that there is a difference between what academics and curriculum designers agree

about the social studies curricula and what is actually implemented in classrooms. Citing a number of sources, Barr found that while 'experts' argue that social studies should deal with few topics in depth, observers reported teachers to provide superficial coverage of several topics. Specialists promote the case for conceptual understanding of broad ideas but observers reported teaching that emphasises rote recall of factual information. Observers also noted a lack of higher-order thinking, valuing and decision-making in classrooms.

Tasks and teacher decision-making

Eggleston (1979) suggests that decision-making is the central feature of the role of the teacher. "In theory, and even to some extent in practice, most of the activities of the individual classroom are a consequence of the individual teacher" (p.1). When the unique social and cultural contexts of classrooms are considered in conjunction with the many internal and external influences that impact on the tasks teachers decide to assign to students, it is clear that the issues relating to task design and management are complex.

When designing and assigning classroom tasks and activities to suit the varied needs of individual students, the kinds of decisions teachers have to make include the following:

- compatibility of tasks with the national curriculum objectives;
- time available for task allocation and completion;
- purpose and relevance of tasks to both students and to the topic of study;
- task format and presentation to be motivating and attractive to students;
- selection of achievement objectives, learning outcomes, skills and content;
- matching tasks to the interest, skills and developmental levels of students;
- assessment and evaluation procedures;
- organisation of students for group tasks;
- extent to which tasks can be undertaken independently and completed successfully by all students;
- resources required.

Similarly, students are faced with decisions about managing assigned tasks. The type of tasks they are assigned will determine the extent to which they are able to develop and practice real decision-making skills that will increase their sense of autonomy, control, and sense of responsibility for their learning.

An important dimension of tasks is their authenticity (Turner, 1995). The call for authenticity of learning experiences which implies learning experiences based on realistic learning situations has been well documented (e.g., Greeno, 1997). Edelsky (1991) described the three dimensions of authentic literacy tasks as meaning making, purpose, and position. From a psychological perspective, authentic tasks are the "ordinary practices of the culture" pursued in actual, rather than simulated situations (Brown, Collins, & Duguid, 1989, p.34).

Authentic activities allow students to construct and transform knowledge by encountering "interesting phenomena and difficulties through their interaction with the environment" (Collins, Brown & Newman, 1989, p.487). They enable students to use cognitive strategies to monitor construction of meaning, to receive feedback from others about progress and improvement, and to work with others collaboratively to create new ideas. An ultimate goal of authentic tasks is to create classrooms that are 'cultures of practice' in which students learn skills within, as opposed to separate from, their social and functional contexts (Brown, Collins & Duguid, 1989).

There is a tension for teachers between providing authentic, problem-solving activities and offering students explicit guidance. Teachers need to adopt a facilitative rather than a directive role, guiding learning instead of transmitting knowledge (Stein, McRobbie, & Gibbs, 2002). Teachers who teach across a wide range of curriculum areas, particularly at elementary school level, cannot realistically be expected to be experts in all of the areas they are required to teach. As a consequence, by not controlling the content of tasks, they risk challenges to their subject knowledge and their pedagogical content knowledge (Shulman, 1986). Stein, McRobbie and Gibbs (2002) suggest that many opportunities for fostering students' thinking, knowledge, and practical development are lost when teachers' subject knowledge is limited or inadequate. They conclude that if the introduction of authentic problem-solving activities across a number of curriculum areas is to succeed, serious consideration must be given to the nature and extent of teacher professional development.

Tasks and student interest

There is considerable support in the literature for the need for tasks to relate to student interest. As stated by Christensen (1994), "I can sit students in a circle, play get-to-know-you games until the cows come home, but if what I'm teaching in the class holds no interest for the students, I'm just holding them hostage until the bell rings" (p. 15).

Interest determines how students select and persist in processing certain types of information. When students are interested in texts and tasks they attend to them longer and persist with them even if difficult (Turner, 1995). Interest influences the goals students set. When students are engaged by ideas, they are more likely to set learning goals (Csikszentmihayli & Rathunde, 1993). Decisions about how much effort students will make to engage with and complete tasks are dependent to a large extent on how much personal relevance and purpose students perceive in the task. Interest, prior knowledge and experience of similar tasks also influence students' task engagement. "If students sense a 'need to know' factor in the material they are presented with, if it corresponds to an urgent interest they have, they will learn avidly and retain that knowledge" (McMaster & Bonallack, 1997, p. 7).

There is evidence in the literature to show that teachers are aware of the importance of incorporating student' interests in their planning. Zahorik (1996) used a reflective writing procedure to gather data from 65 elementary and secondary teachers involved in a constructivist-learning course. The teachers' thoughts revealed that the generation of interest is a major aspect of teaching. Hands-on activities were reported to be the primary way of establishing interest, although teachers also reported creating interest through use of personalized content, student trust, and group tasks. Teachers reported rarely using content facts and concepts as a way of generating interest. Personalised content was found to exist in three forms: linking the content to students' prior knowledge, experience or known interests; permitting students to generate, often through teacher–student planning, the content to be studied; the teacher selecting from the required curriculum, the content the teacher thinks will appeal to students.

The development of student trust was also found to be important to the teachers. Factors that were considered to enhance student trust were the use of activities that respect students' intelligence, integrity, and pride; permitting students to share their ideas through dialogue, reporting, debating, and displaying work; to make decisions for themselves and use their creativity; and to develop ownership of classroom events through involvement in planning units and choosing tasks.

McPhail, Pierson, Freeman, Goodman, and Ayappa (2000) conducted a study on the role of student interest as a tool for informing curriculum decisions in sixth-grade learning contexts. Brainstorming sessions, plus individual and focus group interviews were used to determine the students' subject interests. Four learning contexts were constructed around these interests with the students participating in their first or second choice of subject. Significantly higher

scores on measures of Affect and Activation were found in students who participated in their first choice. In addition, intra-group unities of preferred and dispreferred ways of learning distinguished groups of students who shared common subject interests from the class as a whole. Students were found to be reliable informants of their interests, and demonstrated their commitment to learning in their preferred subject area. The authors conclude that using students' interests in the design of curriculum can help teachers to understand how to support individual intellectual growth in developmentally appropriate classroom contexts, while fostering students' identities as "competent learners" (p. 65).

Freeman, McPhail and Brandt (2002) conducted a study on sixth-grade students' views of activities that do and do not help them learn. Twenty ways of learning were derived from activity choices during brainstorming sessions. Students were then asked to select and rank the three activities that "helped them to learn best", and the three activities that "helped them learn least well" (p. 335). Individual interviews were also conducted. Students reported that doing experiments, working with friends, and building models facilitated their learning. Conversely, watching movies, drawing, and snacking while learning were considered to be non-facilitative. In addition, the study showed how students can divert their interest to other things while giving the teacher the impression they are paying attention. Working with friends to share their ideas, and opportunities for engaging in tasks with appropriate levels of challenge were reported to aid their learning. Findings from this study have parallels to my own in a number of ways and will be discussed further in Chapter Eight.

McPhail, Pierson, Goodman and Noffke (2004) conducted a study in the area of student interest and choice with ten middle school students identified with learning disabilities. The ten students worked within a teacher-student apprenticeship based on their interest in art. Within the apprenticeship, the students worked with a professional sculptor to create two sculptures each. Their experience transformed their learning narratives from disabled to abled, interested, engaged, and competent learners in their own eyes and in the eyes of others. When guided by a competent mentor, interest -based learning was found to provide learning opportunities for students with specialised learning disabilities that are not commonly found in conventional schools. Findings support the idea that the potential for students with learning disabilities to experience transformational learning is enhanced or limited by the educator's ability to creative educative contexts for them. As a result of their own intellectual and emotional experience of the power of this type of teaching, the authors are committed to continuing partnership work with mentors and students "... in which shared interest underlies

the design of learning communities and, in turn, creates the space for authentic dialogue that enhances development and self-understanding for all learners" (p. 490).

When student interest is not incorporated in tasks, learners are less likely to perceive the tasks to be of relevance or value to them. The quality of student engagement may diminish as a result (Wigfield & Eccles, 1992). The significance of the time students persist with and are engaged with a task is a critical variable in terms of learning outcomes. Walberg (1999) reported that there were over 130 studies showing a link between time and learning, with the strongest impacts evident when students are engaged in 'aligned time on task'. Brophy (2001) asserts that students learn more when most of the available time is allocated to curriculum-related activities, and the classroom management system emphasizes maintaining students' engagement in those tasks. Effective teachers allocated most of the available time to activities that were designed to accomplish instructional goals.

Teachers who advocate the involvement of students in task design where their interests could be accommodated, would argue that boredom and frustration would be reduced or eliminated (Wade, 1995; Weeks, 1987). Kohn (1993) agrees but states "the educators who shape the curriculum rarely bother to consult with those who are to be educated" (p. 10). While tasks should be sufficiently interesting and varied to motivate students to engage with them, Ames (1992) warns that variety may serve to detract from the focus if too many dramatic or extraneous effects are used.

Matching tasks to stud ent goals

The importance of matching tasks to student goals is well documented. Motives of learners and their perceptions of the learning situation are considered to determine their learning process. Learning is affected by how a learner perceives a learning task, the degree of effort a learner expends and the kind of processing and regulation activities used during learning (Schellings, 1997).

It is clear from the literature, that there is often a mismatch between the goals teachers set for tasks, and the goals students might have for the same tasks. The difference between teacher and student goals for tasks is not a new concept. Holt (1982) described the reality of competing 'definitions of the situation' held by students and teachers.

> It has become clear...that these children see school almost entirely in terms of the day-to-day and hour-to-hour tasks we impose on them. This is not at all the way the teacher thinks of it. The conscientious teacher thinks of himself as taking his students...on a journey to some glorious destination–well worth the pains of the trip. For children, the central business of school is not learning, whatever this vague

> word means; it is getting these daily tasks done, or at least out of the way, with a minimum of effort and unpleasantness. Each task is an end in itself. The children don't care how they dispose of it. If they can get it out of the way by doing it they will do it; if experience has taught them that this does not work very well, they will turn to other means, illegitimate means, that wholly defeat whatever purpose the task giver may have had in mind (p. 37-39).

Research on student motivation and goal setting suggests that students rarely focus on the content goals of school work (Anderson, 1981). Rather, they implicitly ask questions about how to do a task, whether they can do it, and if they want to do it. Students perceive tasks differently, with their perceptions influenced by numerous interacting factors (Schellings, 1997). For example, Butler (1997) referred to such factors as the clarity of task descriptions, the strategies students utilize for interpreting task demands, their previous conceptions about tasks, and whether or not students even recognize that task analysis is something that they should undertake.

Blumenfeld, Mergendoller and Swarthout (1987) propose that it is the form of the task that determines the answers to students' questions because form dictates what they are to do, how to do it, and with whom. These answers influence students' perceptions of the purpose of the task, their understanding of the procedures required, their perceptions of task-specific abilities, and their interest in completing the task. These perceptions also affect how students approach tasks, and their cognitions and behaviour while working (Ames & Ames, 1984).

According to Pintrich, Marx and Boyle (1993), students adopt different goals and purposes for schoolwork, and that "becoming cognitively engaged in a myriad of classroom academic tasks is a choice they can make for themselves" (p. 169). Student lack of awareness of task demands was given as a possible explanation in interpreting the students' problems with attuning to different selection tasks (Schellings, Van Holt-Wolters, & Vermunt, 1996). Where tasks are not clearly defined, students must define the tasks for themselves and set their own structures for them. Problems arise when students do not perceive the tasks in the same way as the teachers and may not understand what cognitive resources are appropriate for different tasks. In addition, teachers may also have different ideas about the instructional objectives to be achieved.

Task demands, which are set by teachers in secondary education, may not only differ between, but also within subject topics (Elshout-Mohr & Van Hout-Walters, 1995). Within the same subject topic (biology), secondary teachers showed little consistency in selecting

relevant information or key phrases that their students should learn in preparation for an exam (Shelling & Van Hout-Walters, 1995).

Lee and Anderson (1993) consider that science educators have long been concerned that many students fail to engage in academic tasks with the goal of achieving better understanding in science. Their study examined the patterns of student task engagement to factors involving their cognition. Findings showed limitations in the patterns of communication among the students about their scientific reasoning. Although the students worked together on hands-on activities, classroom discussions were dominated by student-teacher communication, and the teachers were the primary evaluators of students' work. Thus, students were able to meet the teachers' minimal standards without being challenged to reconcile their reasoning about science with the quite different reasoning of their peers. The second limitation in the instructional programme concerned the lack of attention to issues of race, culture, and social class. The authors concluded that eventually the success of science teaching may depend on the establishment of a kind of 'social bonding' in which both the teachers and the curriculum accommodate students' agendas, needs, and socio-cultural backgrounds in such a way as to lead the students into identifying the goals of science as their own.

Students' perceptions of tasks and of their own competence affect their level of task engagement. Anderson, Stevens, Prawat and Nickerson (1988) suggest that students must learn to respond to task demands imposed by their teachers, and that their ability to do so is influenced by certain task-related beliefs. Responses from students in 19 third and fourth grade classrooms identified two dimensions of teachers' practices associated with more desirable patterns of students' beliefs: the extent to which teachers structured the information about the environment to render it predicable and comprehensible, and the frequency of opportunities for students to regulate their own task activity. Teachers in highly rated classrooms created opportunities for students to monitor themselves during task performance while holding them accountable for task completion. This was achieved by allowing some choices within limits, not by abdicating all monitoring responsibility to students.

Tasks and motivation

There is an increasing body of research relating to the effects of tasks on students' learning and motivation, and on the behaviour of both teachers and students. Motivation is defined as an internal state that activates, guides, and maintains behaviour (Schunk, 1990). Motivation to complete an academic task results from a complex interaction of learner and instructional

setting factors (Brophy, 1998; Stipek, 1996). Theories of intrinsic motivation describe four characteristics of tasks that promote greater student engagement. These include opportunities for challenge and self-improvement, student autonomy, pursing personal interests, and social collaboration (Turner, 1995).

Pintrich, Marx, and Boyle (1993) identified three aspects of an individual's behaviour as the three traditional behavioural indicators of motivation. These include the choice of a task, the level of engagement or activity in the task, and a willingness to persist at the task. Pintrich et al. consider it important to build connections between the motivational and cognitive components of student learning.

Based on a review of the literature on how teachers might design tasks to promote student motivation to learn, Miller and Meece (1999) identified three key recommendations. First, academic tasks should require the use of various self-management and self-regulatory learning strategies (Ames, 1992; Paris & Turner, 1994). Next, academic tasks should give students opportunities to use prior knowledge to construct their own understandings of the content under study (Lepper & Modell, 1989; Meece, 1991). Finally, academic tasks that provide opportunities for students to study collaboratively are thought to be more challenging than those studied alone (Ames, 1992; Paris & Turner, 1994).

Paris and Turner's (1994) review of research in the area of student motivation provides a useful overview. Paris and Turner propose that analyses of motivation should consider the characteristics of individuals in specific situations because a person's motivational beliefs and behaviour are derived from contextual transactions. Among their findings are the following:

- complex and challenging tasks afford more opportunities for self-regulated learning than activities that are highly specified by the teacher;
- when the focus of instruction is on practice, rote application of rules, and adherence to teacher specified activities, students place little value on the tasks and display less motivation;
- when students are involved in tasks that include ample opportunities for choice, challenge, control, and collaboration, they are more likely to display independent, strategic, and motivated behaviour for learning;
- students who believe their school work is interesting and important are cognitively engaged in trying to learn and understand the material;

- perceived task value significantly predicts the extent to which students voluntarily use strategies in learning situations;
- students who perceived tasks to be interesting and worthwhile also reported more self-regulation and persistence;
- when students make personal choices about the books they read, projects they pursue, stories they write, they are more likely to be thoughtfully engaged in the tasks;
- choice leads to commitment, deep involvement, and strategic thinking with tasks;
- children who perceived their classrooms to be autonomy-promoting reported greater interest in their school work, greater perceived confidence in school, and generally positive feelings of self-worth.

Cordova and Lepper's (1996) study found positive effects of incorporating student choice, contextualisation, and personalization of tasks with elementary school students. Effects included increased motivation, deeper engagement in learning, an increase in the amount learned in a fixed time, and increases in the students' perceived levels of competence and aspiration.

Turner's (1995) study into the influence of classroom contexts on young children's motivation for literacy found that the strongest predictor of motivation was the literacy task. 'Open' tasks that influenced children's motivation were opportunities for challenge, for student control, for satisfying interests, and for collaboration. Turner proposes that the tasks selected by teachers represent to students what literacy is, why it is important, and what it can do. Tasks influence students' learning goals by predisposing them to link literacy with specific cognitive activities, and by focusing students on certain uses and purposes for literacy. Turner found that because students experience literacy through the tasks they complete, tasks define (and sometimes limit) how students come to understand literacy. Literacy tasks link literacy to thinking processes and communicate messages about the purposes and uses of reading and writing. While Turner's findings are specific to literacy, they could equally apply to other curriculum areas.

Green (2001) explored verbal motivational strategies in exemplary teachers' classrooms. Green applied a framework derived from expectancy-value theory, which addresses student motivation for academic tasks. This theory asserts that the amount of effort people (students) are willing to expend on a task is a product of the degree to which they expect to succeed at the task, and the degree to which they value the task and value success on the task. Green found that the second-grade teachers in her study made a higher number of comments related

to expectancies, and relatively fewer to valuing tasks. The infrequent use of comments that address the usefulness or value of tasks was consistent with previous research. For example, Zahorik (1996) found that teachers rarely used inherent interest in tasks as a motivational strategy. Brophy (1999) discusses the lack of attention in classrooms in relation to appreciation of the value of tasks, or the importance of deeper learning goals. Green (2001) concludes that teachers may be under-utilizing motivational strategies that convey the value of tasks. For example, teachers may believe that encouraging a student is important, but neglect to confirm this after students complete tasks.

When students are allowed to make decisions about their academic work, they are likely to be more interested in and committed to those decisions. Conversely, controlling events undermine intrinsic motivation by limiting student participation, standard setting, and decision-making (Turner, 1995). Learning will be more productive when learners choose and determine their personal objectives (Schellings, 1997). However, learning can also be successful and productive when objectives are put forward by the instructional source (e.g. teacher, textbook) on the condition they are accepted and adopted by the learners (De Corte, 1996). Effective learners are self-regulated. They actively analyse the instructional tasks that are assigned, set productive objectives, select strategies to achieve these objectives, monitor their progress in relation to task criteria, and adaptively adjust strategic processes to foster success (Butler, 1997).

Alton-Lee (2003) found that there are multiple research literatures across a range of curriculum areas that have identified the sustained higher achievement that occurs when teachers use pedagogical approaches that effectively support students in taking charge of their own learning. Research linking learning orientations to student outcomes demonstrates that effective teachers promote a learning orientation by introducing activities with emphasis on what students will learn from them. Mistakes are treated as natural parts of the learning process, and students are encouraged to work collaboratively and help one another. Students are taught to ask questions without embarrassment, to contribute to lessons without fear of ridicule of their ideas, and to collaborate in pairs or small groups on many of their learning activities (Brophy, 2001).

Tasks and challenge

The key ingredient in motivating tasks is moderate difficulty (Clifford, 1991). Moderately difficult tasks help learners calibrate their progress toward a goal by providing them with information about progress as well as concrete evidence of accomplishments (Bandura, 1982).

Conversely, low challenge tasks can have a debilitating effect on motivation when students assigned low challenge tasks perceive them to be evidence that others hold low expectations for them (Turner, 1995). When tasks are perceived to be too simple and lacking in challenge, or too difficult and unachievable, they are unlikely to be undertaken other than superficially. Students have to make decisions about what is required of them to complete tasks to an acceptable standard, therefore understanding the teacher's goals and standards of performance on the task are essential (Pintrich, Marx & Boyle, 1993).

Mergendoller, Marchman, Mitman and Packer (1988) assessed the level of cognitive demand inherent in, and the manner in which students were held accountable for a range of tasks in seventh grade life classes during two instructional units. In general, tasks presented minimal cognitive demands. In discussing their findings, the authors found a consistency with studies such as Bennett and Deforges' (1984), which found that 60% of tasks assigned by teachers were practice tasks in which the student was familiar with both the content and the context of the problem. Tasks focusing on new material made up 25%. Tasks requiring students to discover invent or construct made up only 7% of the tasks sampled. Mergendoller et al. emphasised the need for teachers to ensure the tasks they assign to students are meaningful and challenging.

Miller and Meece (1999) found that third grade students who had frequent opportunities to complete high-challenge tasks preferred this kind of work because they got to make up their own responses, experienced positive emotions, and expended the greatest effort. Conversely, low and average achievers who had fewer opportunities to complete high-challenge tasks typically paired negative learner responses with positive content responses. Although the students had high expectations for the low-challenge tasks, they expressed a strong lack of interest in them as they were boring, meaningless, and minimally challenging.

As a way of supporting learners to engage with high-challenge tasks, Miller and Meece (1999) promote the use of scaffolded instruction (Vygotsky, 1978; Rogoff, 1990), suggesting that "with exposure to challenging tasks and instructional support, students are more likely to develop those cognitive and motivational abilities that characterize independent learners" (p.30). A further application of Miller and Meece's findings relates to how teachers can promote motivation by offering academic tasks of moderate challenge that progressively build on each other, expand students' skills, and offer a range of response options (Ames, 1992; Lepper & Modell, 1989; Paris & Turner, 1995).

Tasks and Social Relationships

Classroom tasks have been found to have a significant influence on peer social relationships. Bossert's (1979) landmark study of social relationships in classrooms found that student relationships, peer status, and engagement were shaped by the teacher's instructional design, task format and management, and grouping practices. Findings from Nuthall's (1999) series of classroom-based studies into student classroom experience and the relationship between their experience and learning outcomes demonstrated that teachers need to design tasks in such a way that foster positive social relations amongst peers, and facilitate mutual valuing of knowledge and skills.

Proponents of cooperative learning and social constructivist learning theory advocate the use of collaborative learning contexts (Vygotsky, 1978; Johnson & Johnson, 1998; Palincsar, 1998; Thompson & Brown, 2000). Cohen (1994) reviewed research showing that the relative status of an individual within a group may determine the individual's participation in collaborative tasks. Status based on gender and race has been found to have an influence on decisions that are adopted by the collaborative group (Cohen & Lotan, 1995).

Recognising the difficulty in arranging productive peer learning situations, Palincsar and Herrenkohl (2002) describe two contexts designed to promote collaborative learning. The first is Reciprocal teaching, an intervention designed for students with significant disparities between their ability to decode and comprehend text. Students and teachers take turns to lead discussions about a shared text using four strategies: predicting, questioning, summarising, and clarifying. Using the Vygotskian principle of scaffolding, the teacher gradually cedes responsibility to the students to lead and sustain the dialogue. Reciprocal teaching is promoted as a way of developing an 'intersubjective attitude' where everyone shares the responsibility for leading the dialogue while being provided with the necessary support to do so.

The second context is that of cognitive tools and intellectual roles (CTIR), used by the authors in inquiry-based science instruction to promote student engagement and collaboration. CTIR has been found to be of value in supporting classroom dialogue, in advancing student theorising, influencing student thinking about the nature of scientific problem solving, and promoting contextual understanding. Palincsar and Herrenkohl promote the structuring of group activity to encourage the distribution of expertise, with students building on one another's ideas and sharing the responsibility for their learning. The importance of the reporting phase of science lessons where students share, compare, agree with, or refute their findings is highlighted. The importance of the reporting of science lessons is particularly

applicable to my own study and will be discussed further in Chapter Eight. Palincsar and Herrenkohl conclude with the need for teachers to understand more fully how to socialise students into new ways of dealing with their peers as intellectual partners.

In another study, Palincsar, Brown and Campione (1993) demonstrated how reciprocal teaching procedures can be used to foster the development of a learning community in a first-grade classroom. Using the four strategies previously outlined, the students in the reciprocal teaching discussion groups demonstrated changes in their ability to understand text, identify the 'gist' of the meaning of the passages read, and to recognise the analogical information in the texts. When teachers implement such programmes, the diverse experiences and knowledge brought by the children enables each participant to make a worthwhile contribution to the group's emerging understanding of the carefully selected text. As concluded by the authors: "In such a context, classrooms of diverse learners become communities of knowledge users" (p.55).

Chizhik (2002) compared the effects on learning of collaborative group work on single-answer group tasks and variable-answer group tasks. Chizhik found that variable-answer group tasks provide a more equitable environment for participation than single-answer group tasks. Chizhik's findings suggest that variable-answer tasks may provide an environment where low-status students may be taken more seriously and receive more attention than when working on single-answer tasks. These findings are consistent with Cohen (1994) and Cohen, Loten, Scarloss and Arellano (1999) who found that variable-answer tasks produce an environment where learning through participation takes place. Variable answer tasks may allow for a lot of interaction on group decisions, as there are no correct answers. Conversely, with single-answer tasks, once a correct suggestion has been offered, the group must move on without much discussion.

However, other researchers (Webb, 1991; Webb & Palincsar, 1996) found that learning takes place in single-answer tasks where elaborate explanations are generated, and prompt answers follow any questions that arise within the group work. Single-answer tasks have also been found to increase learning in peer tutoring situations (Fuchs, Fuchs, Mathes, & Simmons, 1997).

There is increasing evidence of the benefits of peer dialogue to enhance achievement. Colbert and Taunton (2001) reviewed classroom research in the visual arts and found that the effects of student-student interactions were as important as student-teacher interaction. Research on

the impact of student learning outcomes shows marked variation depending on the skill of the teacher in promoting constructive peer-interaction and dialogue around curriculum ideas (Alton-Lee, 2003). Wilkinson, Hattie, Parr, Townsend, Thrupp, Lauder and Robinson (2000) emphasized higher-level cognitive processes, enhanced learning outcomes and increased interest as a result of effective facilitation of peer collaboration.

Research on task contexts suggests students are most likely to learn and remember new information when they have the opportunity to engage with new information across multiple tasks contexts, including tasks that enable cooperative learning in small groups and pairs (Alton-Lee, 2003). Concerns have been raised in the research literature about ethnic stereotyping associated with particular task contexts (Hohepa, McNaughton, & Jenkins, 1996), and individualised instruction where learners follow self-paced, individualised modules (Lipsey & Wilson, 1993). In contrast, small group and whole-class discussion enables key ideas from individual or group work to be brought to the surface. An international review of task context use in mathematics found that whole-class discussion following individual or group work improves student achievement (Grouws & Cebulla, 1999).

Alton-Lee's 'Best Evidence Synthesis' (2003) provides examples of New Zealand research that shows that the teacher's ability to scaffold learning in an environment that scaffolds a student's understandings is critical to teaching effectiveness (for example, McDonald, 1993; Clay, 1979; Phillips & Smith, 1999). Consistent with Vygotskian theory, the principle of teaching within the student's zone of proximal development implies that students will need explanation, modelling, coaching, and other forms of assistance from their teachers. As a result, students will ultimately be able to use what they are learning and regulate their own productive task engagement independently.

Matching tasks to students' skills and understanding

Tasks are often poorly matched to student abilities and skill levels (Bennett & Desforges, 1988). Bennett and Desforges provide evidence that teachers tend to under estimate low attainers. The authors state that the reasons are complex and include inappropriate classroom management strategies, lack of adequate identification of students' problems, and a concern for mechanical progress at the expense of student understanding. The authors conclude that once teachers emphasise children's thinking processes over work products, they will be free to adopt the same priorities and to focus on the quality of children's learning experiences.

Tasks are less likely to match the needs of individual learners when all students are working towards the same instructional goal. This is more likely to occur when teachers maintain full control over the instructional decisions (Marx & Walsh, 1988). Effective teachers are sensitive to the diverse range of their students' individual needs. The constraints on their practice due to class size limits the extent to which teachers can provide tasks suited to individuals or small groups, and may sustain practice that uses whole class 'one-size-fits-all tasks'.

Incompatible with constructivist pedagogy is the increasing availability and use of commercially produced resources covering a wide range of curriculum areas and topics. Such resources are regarded as an attractive alternative for busy teachers coping with the demands of a crowded curriculum. Although these resources may be based on learning outcomes and content prescribed by the curriculum, they cannot be based on any reliable diagnostic assessment of the needs of individual learners. Brophy and Alleman (1991) report that activities in commercial texts suffer from poorly conceived attempts to include variety or enhance interest. These attempts are not well matched to, or may actually obscure, content goals (Blumenfeld, 1992).

When the content of a task is inappropriate, learners may become bored or frustrated. Task objectives that are not easily met, or not met at all may be stressful for learners, as are too many overly simple, routinised tasks such as worksheets, choral responses, repetitive copying, and recognition tests. According to Corno and Rohrkemper (1988) "Boredom is the stress of tedium, just as frustration is the stress of difficulty" (p.298). When tasks are either too simple or too difficult, student behaviour may be adversely affected, resulting in teachers reverting to tasks of a more prescriptive nature in an attempt to reduce opportunities for off-task behaviour. Kohn (1995) suggests that there are strong links between inappropriate task

content and off-task behaviour, advocating that when students are off-task, the teacher's first response should be to ask, "What's the task?" (p.19).

Students develop strategies for managing tasks, particularly when they do not understand the requirements of the task. Doyle (1983) reported that when tasks are risky or ambiguous, students negotiate down the requirement. Student cooperation in the lesson decreases, making it difficult for the teacher to maintain lesson flow and pacing. In response to student reactions, teachers often diminish the cognitive level and challenge of the task by redefining its parameters. Students may be told exactly what to do or how to think. In addition, the teacher may alter the grading system for the task by placing a premium on effort or participation, or by giving credit for the less difficult aspects.

Studies have found that teachers and students focus on superficial aspects of tasks and that attention in classrooms is often dominated by concerns for maintaining order and finishing assignments (Anderson, 1981; Blumenfeld, Pintrich, Meece, & Wessels, 1982; Nuthall, 1999; 2001). As a result, teachers often concentrate on giving directions for completing and handing in work rather than explaining the substance of assignments and students have little understanding of the meaning or purpose of the work they do (Carter & Doyle, 1987).

Reviewing findings from his extensive series of classroom-based research, Nuthall (2001) observed in depth how teachers managed the activities they designed. Nuthall concluded that what was immediately apparent was that teachers do not talk to students about learning or thinking. Instead they talk about management issues such as paying attention and not annoying others. Teachers talk about the resources the students will need to use; about how long the activity should take and what will happen if it's not finished on time. Nuthall found that students' talk is largely concerned with the same things as teachers. In addition to constantly comparing how much they have done, students were observed to focus on the superficial 'management' aspects of tasks such as how long will it take, whether the headings have to be underlined, where their peers found an answer, and if the task had to be finished for homework.

Characteristics of effective tasks

There is an increasing body of literature relating to characteristics of effective tasks and task management. Nuthall (1999) suggests the need to create tasks with the following characteristics: (presented in summary form)

- transparent goals that relate to the interests and motivations of the student. Students need to be able to understand and assimilate the goals and purposes of the tasks as much as they are able to understand and assimilate the activities that are required by the tasks.
- a known relationship to the other cultural contexts in which the students have been, or are being socialised. Teachers need to understand what similarities and differences exist between the different socio-cultural contexts in which students live.
- a set of component activities that mirror the unconscious knowledge processes that constitute working memory.
- Tasks must be designed to engage specific social processes of the kind that will enhance effective and sustaining relationships between students.
- The tasks should have the effect of increasing levels of acceptance, trust, sharing, and mutual support that occurs between students.
- Taken together, tasks need to involve as wide a variety of different kinds of activities as are relevant to the curriculum (p. 248).

An important consideration in the design of effective tasks is the number of opportunities students have to interact with the concepts that have been selected by the teacher. One of the key findings from Nuthall and Alton-Lee's (1993) analyses of student experiences of curriculum was that the timing of instruction should be responsive to the constraints of student working memory span. In their research with Year 5 and 6 students, Nuthall and Alton-Lee found that when a student has three to five opportunities to interact with a new idea within a time period that enables previous information to be related to new information, then learning can occur. For optimum effectiveness, there should be no more than two days between each exposure to the concept for it to be committed to long-term memory. To support the developmental sequence of construct generation, Alton-Lee and Nuthall (1998) promote "the organization and timetabling of instructional units to ensure dense and recurrent access to relevant topic content through inter-linked classroom activities" (p. 17).

In the 'Quality Teaching for Diverse Students in Schooling: Best Evidence Synthesis' (Alton-Lee, 2003), ten characteristics of quality teaching derived from a synthesis of research

findings of evidence linked to student outcomes were identified. Those characteristics that are particularly relevant to classroom tasks and activities were as follows:

Characteristic 1: Quality teaching is focused on student achievement (including social outcomes) and facilitates high standards of student outcomes for heterogeneous groups of students.

- Quality teaching is focused on raising student achievement (including social outcomes).
- Quality teaching facilitates the learning of diverse students and raises achievement for all learners.
- The teacher establishes and follows through on appropriate expectations for learning outcomes and the pace at which learning should proceed.
- High expectations are necessary but not sufficient, and can be counterproductive, when not supported by quality teaching.

Characteristic 2: Pedagogical practices enable classes and other learning groupings to work as caring, inclusive, and cohesive learning communities. Task-related research-based characteristics include:

- Teaching and tasks are structured to support, and students demonstrate, active learning orientations.
- Teaching includes specific training in collaborative group work with individual accountability mechanisms, and students demonstrate effective cooperative and social skills that enable group processes to facilitate learning for all participants.

Characteristic 3: Effective links are created between school and other cultural contexts in which students are socialised, to facilitate learning.

- Relevance is made transparent to students.
- Ways of taking meaning from text, discourse, numbers or experience are made explicit.
- Quality teaching recognizes and builds on students' prior experiences and knowledge.
- New information is linked to student experiences.

Characteristic 4: Quality teaching is responsive to student learning processes.

- Teachers have knowledge of the nature of student learning processes in the curriculum area, can interpret student behaviour in the light of this knowledge and are responsive, creative and effective in facilitating learning processes.

Characteristic 5: Opportunity to learn is effective and sufficient.

- Curriculum enactment has coherence, interconnectedness and links are made to real life relevance.
- Students have opportunities to resolve cognitive conflict.
- Students have sufficient and appropriate opportunities for practice and application.

Characteristic 6: Multiple task contexts support learning cycles.

- Task cycles match developmental learning cycles of students.
- Task cycles enable students to engage in and complete learning processes so that what is learned is remembered.
- Optimal use is made of complementary combinations of teacher-directed grouping, co-operative groups, structured peer interaction and individual work (including homework) to facilitate learning cycles.

Characteristic 7: Curriculum goals, resources including ICT usage, task design, teaching and school practices are effectively aligned.

- Curricular alignment: The use of resources, teaching materials and ICT is aligned with curriculum goals to optimise student motivation and accomplish instructional purposes and goals.

Characteristic 8: Pedagogy scaffolds and provides appropriate feedback on student task engagement.

- Tasks and classroom interactions provide scaffolds to facilitate student learning.
- Teaching develops all students' information skills and ensures students ready access to resources when needed to assist the learning process.

Characteristic 9: Pedagogy promotes learning orientations, student self-regulation, meta-cognitive strategies and thoughtful student discourse.

- Quality teaching promotes learning orientations and student self-regulation.
- Teaching promotes meta-cognitive strategy use by all students.
- Teaching promotes critical thinking.
- Teaching makes transparent to students the links between strategic effort and accomplishment.

Characteristic 10: Teachers and students engage constructively in goal-oriented assessment.

- Teachers and students have clear information about learning outcomes.
- Students have a strong sense of involvement in the process of setting specific learning goals.
- Pedagogy scaffolds and provides appropriate feedback on students' task engagement.

In summary, the literature reviewed in this section confirms the significance and complexities of classroom tasks and activities and the way in which they are designed and managed by both teachers and students. On the surface, classroom tasks and activities and the procedures and instructions for carrying them out may appear to be quite straightforward. However, as a result of the differences in the way that students interact and negotiate the purposes and requirements of activities, the process of carrying them out may be far more complex than

they may appear, and may impact significantly on opportunities for individual students to learn.

Consistent with a constructivist view of teaching and learning, there is consensus in the literature that teachers need to design tasks that allow students to collaborate and develop into autonomous learners. This presents a considerable challenge to teachers due to the many socio-cultural factors that impact on teachers' practice and students' classroom experiences. The wide variation in students' cultural backgrounds, interest, spread of ability and large class numbers all exert a significant influence on task design and management.

There is a strong emphasis in the literature on the importance of matching tasks to students' goals and interests. Tasks that are perceived to be interesting, challenging but achievable, and relevant, are more likely to motivate students to engage with them. While much has been written about the characteristics of effective tasks, there is an established need for in-depth studies of the unique ways in which individual students negotiate their way through classroom tasks. In the literature reviewed, there appears to be a paucity of studies that incorporate students' voices in relation to their own perceptions of classroom tasks and activities.

Classroom discourse

This section reviews literature on classroom discourse. As this thesis is concerned with the opportunities that teachers do, or alternatively do not provide for students to learn, the literature included in this section has been selected to highlight two key aspects related to classroom discourse. These include issues related to the relative participation of teachers and students in classroom discourse, and issues related to teacher and student questioning. The section commences with a discussion of the significance of classroom discourse. This is followed by a review of literature that highlights the tension between teachers' stated constructivist and socio-cultural approaches to teaching and learning, and the extent to which classroom discourse continues to be dominated by teachers. The significance of teacher and student questioning on the construction of knowledge is then discussed. This section concludes with a review of studies where teachers have implemented interventions and strategies that have proven to be effective in promoting greater participation by students in meaningful classroom discourse with teachers and with their peers.

The significance of classroom discourse

Using classroom discussion as a method of instruction and for teaching students how to interact verbally with others is not new. Over 50 years ago, Schwab (1954) was clear about his belief that classroom discussion was imperative for developing in students the "intellectual arts" of thinking and communication. Schwab defined discussion as "an engagement in and a practice of the activities of thought and communication" (p. 55).

Teachers have always played a crucial role in managing and controlling classroom interactions and discussion. Traditional modes of instructional interactions between teachers and students were largely dominated by teachers and often consisted of recitation and teachers simply telling and validating answers for students. Studies of patterns of whole class interaction from the 1970s onwards have found a quantitative imbalance of contributions, a lack of reciprocity in the exchanges, and an imbalance in control, or power relations (Burns & Myhill, 2004).

As a result of the research on classroom discourse that has been conducted over the past three decades, the way that educationalists now view classroom discourse has changed considerably. The prominent role that classroom discourse plays in shaping students' beliefs and understandings of subject matter is now widely accepted in the educational community. Studies undertaken from a socio-linguistic perspective indicate the way in which language

plays a critically important role in learning (Newton, 1999). It is through language that the cultural tools and 'ways of seeing' of a community are made available to learners (Vygotsky, 1978). Crespo (2002) explained that "The way ideas are exchanged in the classroom are known to send overt and covert messages to students about the norms of thinking and knowing that are accepted and valued" (p. 739).

Those who adopt a socio-cultural approach to curriculum acknowledge the role of language in mediating the construction of communities with shared discursive practices (Rowell & Ebbers, 2004). The use of language is much more than an exchange of information; language constitutes the discourse that mediates the social practices of specific communities (Lemke, 1995; Wells, 1995). As such, discourse is language-in-use (Gee, 1999); it is socially situated in sustained social relations between participants in face-to-face interactions, or between authors and readers in written texts (Hicks, 1996). "From this viewpoint, ways of doing things in particular communities (cultural) and ways of communicating (social) pervade specific situations" (Rowell & Ebbers, 2004, p. 265).

Hellermann, Cole and Zuengler (2001) concur with Hicks (1996) in proposing that meaningful classroom conversations are more than the content of the words used by teachers and students. The way in which conversations proceed and how they function to provide learning opportunities for students are influenced by the structure of the utterances, their order in the flow of talk, and how participants are recognised and responded to. Hellermann et al. add that these conversational practices are not static or uni-directional, nor do classroom conversations occur randomly. Patterns of interaction evolve over time, with the co-operation and participation of the interactants. Erikson (1996) regards classroom interactions as having a certain 'messiness' about them, rather than being polite dialogues between teacher and student.

It is now well established that classroom discourse tends to promote student achievement when it actively involves them in the production of knowledge and when the discourse is highly interactive (Hall, Allan, Dean & Warren, 2003). As active participants in discussion, students construct an understanding of the topic (Johnston, Anderman, Milne & Harris, 1994). As pointed out by Lemke (1998) "The mastery of academic subjects is the mastery of their specialised pattern of language use" (p. 81). Moreover Palincsar (1998) pointed out that "From social constructivist perspectives, interactions such as those achieved through classroom discussions are thought to provide mechanisms for enhancing higher-order thinking" (p. 357). Larson (2000) underlined this view in stating that discussion is considered

to be a useful technique for developing higher-order thinking skills that enable students to interpret and analyse information.

Tensions between teacher beliefs and practice

As a result of an increase in understanding the way students construct knowledge, many researchers and teachers, particularly those in science education, now espouse a social constructivist view of teaching (Lapadat, 2000). Yet with an increasing understanding of the role of discussion as a way to help students construct knowledge and to help students learn how to go about the process of "discussing," teachers continue to be a crucial variable in creating such a context (Larson, 2000).

There is considerable research evidence, however, to show that while teachers may purport to subscribe to a constructivist approach in general, and understand the significance of classroom discourse in teaching and learning in particular, their stated beliefs are often not applied in their classroom practice.

Black (2004) argues that in order to really understand the impact of teacher-student interactions on children's learning, there is a need to recognise the institutional values, social relations and the unequal distribution of power which permeate the context of the classroom. Such an understanding can only be achieved if teacher-pupil talk is observed and analysed within a framework which recognises each teacher-pupil interaction as an implicit mechanism which influences future events, directs and reproduces pupils' social positioning within the classroom and contributes to the development of their long-term identities as 'learners'.

Effecting improvements in classroom discourse is more complex than simply ensuring students have the opportunity to answer questions or participate in discussions. Although there is a wide body of research to support the benefits of moving away from traditional, teacher dominated modes of interaction to those modes that encourage student participation, traditional modes of instructional interactions seem stubbornly resistant to change (Crespo, 2002). In addition, teachers are often unaware of the significance of the range of socio-cultural factors that impact on students' experience of the classroom. For example, Lapadat (2000) investigated the nature of discourse in the co-construction of science understandings during one-to-one tutoring with two grade six and seven students. Data was collected over six individual weekly one hour tutoring sessions. Lapadat used a design focusing on individual experiences during an instructional unit similar to that described by Alton-Lee and Nuthall (1992).

Summarising her findings, Lapadat noted that the characteristics of the interactions, the process and substance of the co-construction of knowledge, and the resultant conceptual changes differed for the two students. They came to the sessions with different knowledge, interests, beliefs, interactional styles, and role expectations, which elicited different instructional focuses and interactional patterns on her part as instructor. Lapadat found a range of factors influenced the different ways both the students and she experienced the sessions. These included the social and physical context, the cultural knowledge or texts embodied in session material, the character, knowledge, and actions of each participant, the events enacted, and the discourse that emerged. How each student constructed understandings, and whether these resulted in conceptual change, depended on his/her prior conceptions and inclinations, as well as the ways in which Lapadat, as co-participant, scaffolded the discourse and interactions with science materials. Lapadat concluded that "Understandings that emerged were on-going and elusive" (p. 11).

Incorporating less traditional patterns of discourse into teaching practice is more difficult than it appears. According to Romagnano (1994) and Heaton (2000), experienced teachers and teacher educators have often found themselves to be using the same practices they believe are ineffective. The tension between teachers' stated beliefs and their practice, and the impact of a range of socio cultural factors that operate in the classroom, is demonstrated in the following studies.

Ball (1991) found that the traditional teacher response to a correct answer in mathematics was not to make wide use of classroom discourse to reach greater understanding. It was to move on, praise the student, or agree and repeat the answer for the benefit of the rest of the class. Sustained participation in such classroom discourse can result in students believing that learning mathematics is "a straightforward matter", that "staying too long on a problem is a waste of time", and that "making mistakes is an embarrassment rather than an opportunity for learning" (Borasi, 1990). Researchers concur that such teacher responses promote debilitating myths about knowing and doing mathematics (Tobias, 1993).

There is considerable evidence to suggest that many of the verbal exchanges between teachers and students are related to management of procedures or resources, rather than metacognitive matters. A study conducted by Anstey (1993) is particularly relevant to the Project on Learning due to the consistency of findings between the two studies in relation to classroom

talk. Anstey examined the patterns of interaction and classroom talk in two lessons in the classrooms of 9 and 10 year olds. Data was analysed using the following three categories:

1. Management, where the organisation of the lesson occurs or general literacy information irrelevant to the objectives of the lesson is given. For example, "Pencils down."
2. Material logistic where the focus in on the text or the task. For example, "What is the main idea in the paragraph?"
3. Cognitive logistic where the focus is on the cognitive (how) aspect of doing the task (i.e., the skills and processes involved) and the utility (why) of these skills and processes. For example, "Look at the pictures, they might help."

Anstey found that most of the exchanges in both lessons were about management, for example, "Pencils down, read the first page." Both lessons contained a 'reasonable number' of Material Logistic exchanges, for example "What is the main idea? "What can you tell me about...? However, most of those were of the reconstruction type, that is, re-doing the task or simply rephrasing the text, rather than talking about the task. Neither teacher used a significant amount of task-related talk, explicit or implicit. Teacher responses to student answers were general, for example, "Right," "Yes," "Read yours out."

Anstey concluded that classroom talk contains very little teaching about metacognitive matters. The examination of the thought processes involved in the task or the utility of the task is not encouraged, and the time spent on talk about the task and text is mainly concerned about getting the task done rather than informing students about the task. Questioning why lessons are so concerned with getting the task done rather than with cognitive or utilitarian aspects, Anstey suggests that teachers, like the rest of us, may know very little about the cognitive and utilitarian aspects of the tasks/skills/processes they are teaching.

Sahlstrom and Lindblad (1998) conducted a three-year study into the activities of two students in Grade 8 and 9 in a Swedish comprehensive secondary school, and their interactions with peers, the teacher, and artefacts of science. The findings of this study have strong parallels to those of the Project on Learning in relation to the very different ways science may be experienced by individual students. The female subjects in Sahlstrom and Lindblad's study were from different socio-economic groups. One was from a working class family with few friends in or out of school. She rarely performed in the public forum. The other subject was from an upper middle class family, was in a powerful social group, had a high public profile, achieved good grades and was a regular public performer. The student from the upper middle class family was observed to be verbally active for approximately half of the lesson, bidding successfully to interact with the teacher, and spending 19 minutes participating in her group's experiments. In contrast, the student from the lower class family

did not bid for the teacher's attention and spent only five minutes working with the experiment. The dominating verbal activity for her was silence. She was silent for 25 minutes of the lesson and talked about the experiment and the questions for eight minutes.

The authors reported that "Science for the two girls seemed to be a lot less and a lot more than what one traditionally means by the concept" (p.210). Knowledge of academic content and procedures can be used as resources for establishing and maintaining a certain position within a group as it was for the student. This in turn results in a larger social network and frequent opportunities for interaction with the teacher, allowing for a further development of greater previous knowledge. Discussing the implications of their findings, Sahlstrom and Lindblad concluded that "as argued elsewhere... 'discovery learning' seems to be a discovery not always of scientific concepts but rather of issues such as one's social creativity, and of opportunities for identity construction" (p. 212).

In 1999, the National Literacy Strategy introduced a compulsory daily literacy hour into schools in England with the aim of enhancing literacy standards. Rather than achieve the intended increase in interactive teaching with students taking a more prominent role in classroom discussions, Galton, Hargreaves, Comber, Wall and Pell (1999a) found that following the introduction of the National Curriculum in England, teachers in their study spent 67% of the time asking questions, possibly suggesting non-interactive or transmissive teaching. The constraints of the Literacy Hour are summarised by Alexander (2000):

> ...the organizational context is extremely important, because among the reasons why the discourse of classrooms is so unlike everyday conversation is that it is framed and shaped not only by its pedagogical purposes and power differential between teacher and taught, but also by the no less pervasive power of the clock and the crowd. Classroom talk is 'managed' talk; and to manage classroom talk is to orchestrate events, people and time, as well as knowledge, understanding and learning (p. 392-393).

Hall, Allan, Dean and Warren (2003) investigated the nature of the interactions in two year 6 classrooms during the Literacy Hour to determine the extent to which it coincides with contemporary theory on learning discourse. The assumption underlying the authors' approach is that the messages the teacher is supplying in the course of interacting with students about how learning should be done and who is doing it well are of major significance. Hall et al. cite previous studies of interaction during the Literacy Hour showing that teachers adhered to traditional practices of whole class teaching and teacher-led recitation. The Literacy Hour did not appear to promote high quality interaction between teacher and students, with teachers typically prioritising pace and the objectives of the lesson over extending student responses and facilitating higher order interaction. Hall et al. conclude that while teachers are highly

aware of the organisational and pedagogical strategies and decisions they use and make as they teach, they may be unaware of the power of language as a medium of learning and less knowledgeable about the way their discourse impacts on learning opportunities. In the authors' view, increasing teachers' understanding of the role of classroom discourse, particularly interpretative authority, control of topic and the control of turn-taking, is likely to enhance teachers in moving away from recitation as a main mode of classroom interaction.

In a study of the teacher-student interactions in a class of 29 Year 5 students, Black (2004) found that the teacher interacted differently with individual students according to her perception of their ability. The teacher was observed to demonstrate high expectations of some students by according them communication rights over other students. One student was allowed to break the established classroom rules for interactions by correcting another student when she got an answer apparently wrong. Her answer was not wrong, she had simply used an alternate method of calculation. The teacher dismissed her input without consideration of her answer as if the teacher expected her to get it wrong in the first place. Black argues that the teacher's behaviour suggests to both the students involved and to the rest of the class that she believes one student is able to succeed where the other will fail.

Black also found that lack of time forced the teacher to progress quickly through the curriculum to cover all areas. The teacher therefore had to maintain control over the discussions. One way of doing this was to select high ability children to answer the questions as they were most likely to give the correct answers quickly. As a result, other students were denied the opportunity to engage in productive exchanges with the teacher and therefore had restricted access to the understandings that the teacher and the high ability students were able to negotiate. Black concluded that classroom learning is not so much about the individual's acquisition of 'bytes of knowledge' but is about learning how to behave appropriately, learning how to read the context of the lesson, using the right kind of language, and learning how to be perceived as a high ability pupil.

Black's research highlights the need for change in two key areas. Firstly, Black argues that teachers need to be given some degree of ownership over the pedagogic strategies they use, particularly in relation to pace and progression through the curriculum. Teachers can only provide well-structured, engaged and responsive verbal support to all pupils if they are given the time to meet the needs of students on an individual basis. Secondly, teachers need to be encouraged to take a critical view of their own ways of communicating which take into

account the potential long-term impact of implicit assumptions that such verbal behaviour may have.

Black's (2004) findings are consistent with those of Burns and Myhill (2004) who investigated how interactive whole class teaching was and whether teacher-student interactions permitted recoding of information and understanding. Results showed that teacher-led questioning and explanation still dominate. Socio-cultural factors were also shown to be influential. Interaction as participation was differentially experienced by students of higher and lower abilities, and there were few opportunities for student initiation or extended response. In terms of gender differences, girls participated more frequently in positive observable behaviours likely to support learning (such as putting a hand up: joining in a collective response, or being invited to answer); boys were more likely to be involved in negative behaviours, for example, shouting out or being off-task; and there were few child initiated responses but boys were more likely to initiate talk. In addition, results showed that positive observable behaviours likely to support learning were engaged in most by high achieving children, and low achieving children were more likely to be off-task and thus not participating at all. The authors conclude that:

> The whole class teaching represents a dilemma with its problem of establishing relationships and approaches which at once facilitate transmission of a chosen curriculum and wish to enable each individual to have opportunities to interact and co-construct their own understanding...More worryingly, in a heavily accountable teaching culture, highly instructional, objectives-based pedagogy seems to be required, and well-paced, teacher-directed learning are considered valuable, safe approaches...whole class talk is being used by the teacher for 'teaching' rather than being an instrument for learning (p. 47).

Mroz, Smith and Hardman (2000) had previously found that because of the teacher's claim to prior knowledge of the subject content, and right to control the pacing and sequencing of its transmission, pupils rarely managed to impose their own relevance outside of the teacher's frame of reference, resulting in a very low level of pupil questions and pupil statements. Therefore, it is not surprising that English, Hargreaves and Hislam (2002) found that teachers devote more time to telling students facts and ideas or giving directions than 20 years ago.

Lapadat (2000) tapped the essence of the mismatch between rhetoric and practice in her following summary:

> Clearly it is not enough to "talk" construction but still "do" transmission. Yet, despite the emergence of contextualism in theory, educational practice and discourse are still deeply and systematically embedded in positivistic, mechanistic, and transmissive perspectives, which presents a very real barrier to change. One result is that the "reality" we are jointly constructing keeps turning out to be a mechanistic one (p.4).

The significance of questioning

The significance of teacher and student questioning on the construction of knowledge is widely reported in the literature. Research into the particular nature of classroom discourse has shown that it continues to be dominated by questions and statements from the teacher, something that is increasing (Burns & Mayhill, 2004). Researchers are not surprised therefore that students do not spontaneously ask questions of each other when given opportunities to do so (Herrenkohl & Wertsch, 1999).

The type of questions teachers use is considered to be significant. Danielson (1996) promotes teacher use of a range of questioning techniques in response to their ever-changing classroom environment. This includes techniques not only for use in student assessment, but also "to engage students in higher-order thinking, pique their curiosity, and spur them to consider new possibilities" (p. 18). Good teacher questioning skills are defined by Newton (2002) as "asking the right question at the right time in order to achieve your goal" (p. 6). Depending on the context, the right question is one that asks a child to recall a fact or one that makes noticing a relationship more likely. At times, it is to ask for a prediction, requiring the child to make relevant mental connections. At other times, the question is one that helps consolidate and contextualise a child's understanding by asking for it to be applied.

Numerous studies of questioning and classroom interaction have led to several generalisations about classrooms involving class or group discussion. These are summarised by McGee and Fraser (1994) as follows:

1. Teachers usually do not wait for children to think about a question before calling on someone to answer.
2. Most of the questions asked by teachers require nothing more than memory recall.
3. Teachers ask few questions requiring children to use higher-order thinking abilities.
4. A lot of teacher questions and statements are concerned with managing the classroom.
5. The predominant pattern of verbal interaction is that the teacher will ask questions and the children try to guess the answers.
6. Few questions are asked by children in a formal lesson.
7. Teachers use rhetorical questions and instructions such as, "We are going to be quiet aren't we?" Thus, they are asking for effect rather than information (p. 180).

There is evidence in the literature that teacher domination of lesson content and questioning with limited opportunities for students to construct knowledge is not limited to primary schools. The following studies have been selected for inclusion in this review as the principles

related to opportunities for students to actively participate in the discourse of the classroom are consistent with the data from the Project on Learning, and with McGee and Fraser's summary.

Newton (1999), conducted an observational study of 34 lessons in secondary science classrooms in the London area. Newton found that the classrooms were strongly teacher directed with few opportunities given for pupils to contribute to the construction of knowledge in lessons. There were only two cases where the teacher set group discussion tasks, each lasting less than ten minutes. The primary activity tended to be teacher talk, dominated by exposition and teacher-led question and answer interactions. Where practical group tasks were given, these were rarely organised in such a way as to encourage substantive discussion of the science involved. Instead, pupil talk focused on procedural aspects of the practical work. Where pupils were given opportunities for discussion, little guidance was given on how to organise the interactions and the pupils observed experienced difficulties in managing the interpersonal dimensions.

The fact that the teachers had included some practical work in the lessons is evidence of their belief in the value of first hand experiences. However, a close inspection of the way the closed activities were conducted showed they gave little opportunity for students to reflect and make their own generalisations.

Yip (2004) argues that the traditional approach to science teaching where the teacher is mainly concerned with the transmission of established knowledge and algorithms to students, does not lead to effective and meaningful learning. Knowledge acquired in this way is considered to be fragmentary and easily forgotten, and cannot be readily transferable to realistic or novel contexts. When the teacher initiates exchanges, sets the topic, controls the direction of development, and decides which responses will count as legitimate, students are discouraged from articulating their thoughts. There is little or no opportunity for students to show initiative, control the direction of the discussion, or contest the teacher's prerogatives.

Yip's study was to identify the types of questions asked by 14 biology teachers teaching year 9-11 students in Hong Kong. All 14 teachers were university graduates who had specialised in biological sciences and had been teaching for between 3-6 years. The teachers were participating in a part-time two year in-service teacher education programme. As part of the programme, the teachers were introduced to conceptual change approach to teaching,interactive teaching strategies, and microteaching.

Prior to being observed in the classroom, the teachers were asked to identify the misconceptions contained in 20 written statements relating to biological concepts at year 9-11 level. Yip found that despite their university qualifications, the teachers were no better than their students in conceptual understanding and that their subject knowledge might be inadequate for teaching certificate-level biology. The teachers were then observed in the classroom and their questions to students analysed for type (higher and lower-order) and the extent of the use of questions for inducing conceptual change.

Yip found that lower-order questions were most frequently asked by the teachers (31.1%). The proportion of higher-order questions was 25.4%, and conceptual change questions constituted 27.4%. These results were significantly higher than for other comparable studies. For example, Swift, Gooding and Swift (1988) reported that 85.9% of teachers' questions in middle school science were at the recall level.

Yip cautioned that the mere act of asking cognitively demanding questions may not elicit high level thinking or lead to better learning. Yip found that when the teacher asked difficult questions without regard for the students' existing knowledge and level of understanding, they generated confusion and frustration. Students were hesitant to respond and remained reticent as the questions were vague, ambiguous or meaningless. Yip concluded that the teacher's level of understanding of the subject matter is a key factor in the type of questions they ask. Teachers who understand subject matter as a conceptual framework, rather than as a set of established facts, are more likely to plan lessons to help students establish meaningful relationships between existing and new knowledge, and to integrate the new subject matter into their cognitive structures to form a framework of interconnecting concepts.

Teachers, reflecting on their questioning techniques in a study by Freedman (2000), reported that on a typical day they asked about twenty-four questions in a forty-minute class period. The teachers asked twice as many convergent questions as divergent ones. They asked the same percentage of lower-order questions (knowledge and comprehension) as higher-order questions (application, analysis, synthesis, and evaluation). When asked what they could do to develop into better questioners, they replied, "More planning."

The studies conducted by Yip (2004) and Freedman (2000) raise some important issues for consideration. Firstly, teachers are not always well qualified or confident in their own curriculum content knowledge to teach effectively in a particular subject area. As

demonstrated by Yip, this lack of knowledge may be reflected in the explicitness of teachers' questions and can have a detrimental effect on students who may be reticent about answering vague questions. Secondly, the types of questions teachers ask are critical in determining the opportunities for students who may be reticent about answering vague questions. Third, the types of questions teachers ask are critical in determining the opportunities for students to engage in higher order thinking. Finally, teachers appear to ask considerably more convergent than divergent questions, and lower-order questions proliferate. While the teachers' response that they could improve their questioning techniques with "more planning" may be valid, it would be important for such planning to allow for ample opportunities for students to generate their own questions and to become active participants in meaningful classroom discussion.

The importance of students' questions

The importance of children being able to ask their own questions is widely acknowledged in the literature. This is not a new phenomenon. As demonstrated in the following extract, Holt (1962) was a strong advocate for allowing students to ask their own questions.

> Thus we come to the teaching-learning of the 'right answer'. When it is assumed that the material presented in the classroom is definitive and unchallengeable, that the teacher knows the answers, and that the most effective measure of pupil performance is assessment of the facility with which matching answers can be dredged out for the recesses of the learner's mind, then discovery is at an end.
>
> How much more productive may be the part answer, the incorrect answer which leads to the next question, seeking clarification. How much more creative may be the question which raises doubts about the whole of the material presented. Is it fact, opinion, or fiction? What is the source? Is that source acceptable?
>
> The pupil who begins to ask questions like these is creating a personal structure of inquiry, is evaluating the environment, is developing independence and a capacity to make judgements. This involves self-generating intellectual activity as opposed to making responses to Pavlovian verbal stimuli.
>
> We must not fool ourselves, as for years I have fooled myself, into thinking that guiding children to answers by carefully chosen leading questions is in any important respect different from just telling them the answers in the first place. Children who have been led up to answers by teachers' questions are later helpless they can remember the questions, or ask themselves similar questions, and this is exactly what they cannot do. The only answer that sticks in a child's mind is the answer to a question that s/he asked or might ask (p. 65).

For some teachers, the important questions asked in the classroom are those that are asked by students (Beck, 1998). However, research consistently demonstrates that in practice students ask very few questions in school (Cazden, 1988; Dillon, 1990). Valuing students' questions is based on assumptions about learning. In a theory of learning that values the transmission of

knowledge controlled by the teacher as expert, student questions have no place. However, when learning is viewed as 'knowledge-seeking', student questions become a critical part of the learning process (Beck, 1998).

Biddulph (1990) gave a number of reasons why children's question asking should be encouraged in science lessons. From children's questions, teachers get an indication of what the child's intellectual needs are. A teacher can enhance children's thinking by learning about their views via the questions they ask. Children can raise productive questions that help advance their conceptual ability to 'think scientifically'. Question-asking enables children to extend their ideas and self-direct their learning.

Consistent with Biddulph's findings in science, Faire (1992) found in social studies that when children were encouraged, they wanted to ask questions about content and wanted to go beyond the information provided. Incorporating and encouraging children to ask questions can signal to children that their ideas and queries are important, and often worthy of investigation. The act of considering and asking a thoughtful question is in itself a cognitive exercise which can stretch children's thinking. It can also be very motivating and engaging for children to investigate their own questions (McGee & Fraser, 1994).

Newton (1999) comments that it is not enough for students just to hear explanations from experts (e.g. teachers, books, films, computers); they also need to practice using the ideas for themselves.

> 'The' answers to 'the' questions need to become 'their' answers to 'their' questions. Through practice in posing and answering scientific questions, students become active participants in the community of science rather than just passive observers (p. 556).

Newton concludes that teachers need enculturation into the practice of science teaching just as their students need enculturation into the practice of science. One way of supporting teachers is the provision of appropriate resources materials for scaffolding teachers' initial attempts at adopting new techniques, for example, those that involve argument.

Beck (1998) examined a classroom in which student questions dominated the discourse. The purpose of the study was to determine how the teacher, well known for her use of student questions, was able to reduce the forces that discourage student questions in instruction. Aspects of the teacher's practice that contributed to encouraging student questions included her respect for the well-intentioned learner, her ability to use student questions as steps to the curriculum, and viewing each student question as having potential for learning.

Reticent students

A concern shared by many teachers is how to encourage reticent students to become active participants in classroom discussions (Wilen, 2004). Suggested reasons for why students may be reticent about participating include low self-esteem which produces feelings of unworthiness or inability; fear of being ridiculed which results in inappropriate responses or inaccurate answers; and fear that successful responses are unlikely because the student attributes success to luck or accident are suggested reasons. In addition, cultural differences can arise because some cultures forbid or strongly discourage students from speaking out in classroom settings. Avoidance of conflict, arising because inexperienced, shy or less competent communicators rely on silence to avoid conflict, and communication apprehension, which reflect a clinical fear of communicating with or in the presence of others are also considered to be factors that contribute to student reticence to participate in classroom discussions. Erikson (1996) classifies dominant and reticent students as 'turn sharks' and 'turn dolphins' respectively. Those with conversational expertise may have a distinct tactical advantage over others, availing themselves of opportunities to take over turns at speaking.

The impact of peer culture on students' decisions to participate in classroom discussions is considered to be influential. In their study of how high school social studies students experience and learn from public issues discussions, Hess & Posselt (2002) found that the vast majority of students were positive about the importance of and need to participate. The power of peers, however, was greater than that of the teacher in influencing their decision to participate or not. The authors suggest this finding is worrying as it illustrates how the teachers' goals of achieving some higher level of equality in classroom discussion were undercut by influences over which they may have had little control.

Support for involving all students in discussion lies in the purposes and elements of constructivism. Social constructivists believe that students develop meaning as they become involved in social settings and engage in sustained discourse about issues and problems. The emphasis is on the teacher to provide authentic learning contexts with teacher and students asking divergent questions to encourage higher-order thinking, relating new knowledge to existing frameworks.

Wilen (2004) discusses the two opposing ethical issues related to involving non-volunteering students. Firstly, potentially everyone has something to contribute to a discussion, and morally, we have a reciprocal duty to respond to others and make a contribution. Secondly,

requiring non-volunteers to respond may be perceived to be undemocratic and an invasion of privacy. Wilen (2004) suggests the following ways that teachers can encourage reticent students' participation: by creating a positive social climate where caring for students as individuals and respect for their ideas is demonstrated; design, practice and model essential rules for democratic classroom discussion; prepare students for the discussion; select issues with students' interests in mind; balance large and small group discussion; and apply sound discussion principles.

Hogan, Nastasi and Pressley (2000) examined the discourse components, interaction patterns, and reasoning complexity of four groups of 12 Grade 8 students in two science classrooms as they constructed mental models of the nature of matter, both on their own and with teacher guidance. The key act of participants was working with weak or incomplete ideas until they improved. The teachers were found to act as a catalyst in discussions, prompting students to expand and clarify their thinking. Teacher-guided discussions were a more efficient means of attaining higher levels of reasoning and higher quality explanations. When with a teacher, most of the students' contributions to a discussion were conceptual, reflecting the predominance of the teacher's role as questioner and the students' role as respondents.

In contrast, peer discussions tended to be more generative and exploratory. Students' discourse in peer groups was more varied, and some peer groups attained higher levels of reasoning on their own. Students articulated not only conceptual statements when working together, but also a fair number of questions, queries, and metacognitive statements. The authors found that the students were quite articulate, reflective, and insightful about their group interactions. These findings demonstrate that young students can articulate their ideas and support the need for teachers to provide them with opportunities to lead discussions.

Increasing the effectiveness of classroom discourse

Issues related to increasing the effectiveness of classroom discourse are widely discussed in the literature. Despite the resistance to change, classroom interactions have become an important feature of educational reform efforts. In the United Kingdom, classroom talk has recently re-emerged within policy strategies as significant in raising the standard of learning within the classroom. Both the National Numeracy and Literacy strategies have emphasised the importance of "interactive whole class teaching" where pupils are expected to play an active part by answering questions, contributing points to discussion, and explaining and demonstrating their methods to others in the class (DfES, 2001, p. 26).

Teachers who are considered to be effective in the way they manage classroom discourse appear to share common characteristics and practices. According to Kohn (1996), expert teachers tend to establish a 'working with' (as opposed to controlling) tone and climate in the classroom. Students in these classrooms are observed to address each other and ask questions of other students at least as often as they ask the teacher. There is a high level of active engagement in experiential inquiries and problem-solving with a de-emphasis on facts and right answers. The mutual respect between teacher and students is obvious.

Reform oriented teachers work towards promoting an environment where students share, discuss and debate their ideas, rather than simply telling and validating students' answers. In contrast to the traditional transmission approach, reform oriented teachers promote asking the student to explain and justify their answer, regardless of its correctness. Thus, the focus and point of class discussion is not solely on reporting correct answers, but on exploring mathematical ideas and evaluating their validity based on evidence rather than teacher or textbook authority. According to Hughes and Westgate (1998), at the heart of whole class talk should be "sensitive teacher-led but not teacher-dominated discourse" (p. 48).

Buzzelli and Johnston (2001) examined the complex relationships among authority, power, and morality in classroom discourse. Their interest concerned the ways in which moral values, conflicts of values, and moral dilemmas are played out in the context of classroom discourse. Using their study of a third grade teacher facing the problem of supporting students' competence as writers while also nurturing an awareness of how their writing may influence others, the authors concluded that teachers can still use their authority in the classroom without being authoritarian. When the individual voice is valued, there is also a premium placed on social interactions and the negotiation of everything from classroom processes to personal meanings. In addition, values like responsibility are promoted when students know their voice is valued, resulting in an enhanced sense of their own responsibility to participate effectively. "Put simply, they care about what they say in class, because they know it matters" (p. 882).

Benefits to students of effective modes of classroom discourse are reported to be numerous, especially when students are provided with opportunities for participation in discussion. Significant social and cognitive changes reportedly occur in students when classroom talk shifts from recitation to real discussion. According to Cazden (1988):

> One important shift is from recitation to something closer to a "real discussion"...talk in which ideas are explored rather than answers to teachers' test questions are provided and evaluated; in which teachers talk less and students talk

> correspondingly more; in which students themselves decide when to speak, and in which students address each other directly (p. 55).

Expert teachers in the Iowa Scope, Sequence, and Co-ordination (SS&C) Project (a national Science Foundation-funded science teacher enhancement project conducted between 1990 to 1997, involving approximately 300 teachers) demonstrated the efficient use of higher order questioning strategies, use of wait time (to evoke more lengthy and thoughtful student replies to the teacher's and peers' questions), use of varied and contextual assessments of student understanding, and a commitment to their own growing understanding of subject matter content and concept (Varrella, 2000).

Consistent with the SS&C Project findings, research into wait time has found that the longer the pause (three to five seconds), the more thoughtful the response. Wait time is especially useful when asking higher-order questions (Harris, 2000). Preservice teachers who observed middle and high school science classrooms in western New York state reported that with little or no wait time, short answers were elicited. When wait time was increased, the quality of responses was greater (Freedman, 2000). Erikson (1996) also stresses the importance of wait time, but cautions that it may also increase opportunities for 'turn sharks' to dominate the discussion.

Herrenkohl and Wertsch (1999) designed and implemented a classroom intervention to foster the development of an intellectual community in the context of science instruction in a Grade 3/4 split-level gifted class and a Grade 5 class in an urban district. The specific focus of the study was on the role and value of scaffolding student discussions to advance their ability to co-construct theories and models from the data they collected in the course of an inquiry regarding floating and sinking. Involving a process of negotiation that was guided by the teachers, the intervention incorporated an array of tools such as theory and question charts, carefully planned investigative activities, and opportunities for students to assume a variety of roles. At the conclusion of the 10 week program of study, the authors concluded that the students had developed a new way of thinking about science and created a common set of tools with an accompanying language to talk about their thinking. In essence, the students and the teacher had "crafted a lively intellectual community where real issues were debated and discussed and tough questions were always on the table" (p. 486).

Teacher behaviours that facilitated the above developments included consistently refraining from directing the conversation, and instead using the thinking strategies and theory chart to scaffold the classroom discourse. In addition, the teachers assumed the critical role of

sustaining the groups' work, monitoring for coherence and direction, and interceding when the discussion faltered. The authors highlight the need to make scientific thinking and socio-cognitive roles explicit to students so that they can engage in significant cognitive work together.

Members of the Guided Inquiry Community of Practice have investigated various aspects of inquiry in science education. Reflecting on part of their research during a guided inquiry investigation in a second-grade class, Collins, Maclean, Palincsar and Magnusson (2000) identify the multiple roles played by the teacher, and the discursive choices made by her while questioning students about their understanding of scientific concepts. The authors conclude that the teacher's ability to serve in these roles is enabled or constrained by her own knowledge. The discursive choices made by the teacher can have a range of effects in terms of opportunities for students to build understanding of the phenomenon they are investigating, the extent to which they facilitate students' participation in the inquiry and communicative practices of scientists, and the provision of alternative ways for students who struggle with print literacy to construct and share their understanding.

McKeown and Beck (2004) developed resources called 'Accessibles' to support teachers' implementation of 'Questioning the Author' (QtA), an instructional approach aimed at building students' understanding of what they read. Six teachers implemented QtA in their classrooms in reading and social studies over 7 months. Transcripts of video-taped lessons were analysed for patterns of classroom discourse in terms of the kinds of questions asked, students' responses, and teachers' rejoinders to students. Results showed that the use of the resources changed classroom discourse from teacher dominated and focused on retrieving information, to discourse shared by students and teacher and focused on building ideas from text.

A number of studies into teacher questioning have been conducted in the New Zealand context. Hattie (1999) reported meta-analyses demonstrating teacher questioning to have a positive effect size of .41 on student achievement. Reviewing the literature on classroom discourse, Alton-Lee (2003) states "Quality teaching facilitates thoughtful student discourse. Questions are planned to engage students in sustained discourse structured around powerful ideas" (p. 84). One surprising finding in the literature relates to the importance of scaffolding to support and generate higher-order thinking. Low level and factual questions have been found to be more effective in scaffolding higher order thinking than higher order or open questions. This is particularly true when teachers use higher order or open questions that have

the potential to confuse. According to Alton-Lee, students who are most vulnerable are those "who do not bring the cultural capital of the school to their activities" (p.84). Such students may be left without the metacognitive tools or information about question genre to achieve sustained thoughtfulness.

Teachers participating in the Year 4 numeracy exploratory professional development programme were assisted to move from using questions that would elicit only brief responses, to those that would develop students' strategic thinking. Higgins (2001) reported that as a result of the programme, the teachers placed a greater emphasis on questioning and students' explanations.

Anthony and Knight (1999) reported on the use of an innovation called a 'Think Board' with Year 4 and 5 students. Comprising a large piece of card divided into four sections labelled Symbols, Pictures, Stories and Real Things, the teacher asks students to translate equations into the four sections. Teachers reported that the 'Think Board' encourages students to make connections between different representations and helps to develop the range of mathematical strategies they may use.

In summarising a review of the discourse literature, Palincsar (1998) stated:

> In summary, studies of discourse are generally quite supportive of the benefits of instructional conversation. However, the benefits depend upon the types of talk produced. Specifically, talk that is interpretive (generated in the service of analysis or explanations) is associated with more significant learning gains than talk that is simply descriptive. Furthermore, teachers play an important role in mediating classroom discourse by seeding the conversation with new ideas or alternatives that push the students' thinking and discussion and prepare then for conversation. Finally, it is important to attend to the structure of group activity so that responsibility is shared, expertise is distributed, and there is an ethos for building preceding ideas (p. 365).

From this review of classroom discourse, it is apparent that there has been a shift in understanding of the need to move away from a teacher-dominated, transmission model of teaching, to one based on constructivist principles of teaching and learning. It appears however, that this understanding has yet to be incorporated into the classroom practice of many teachers who continue to direct and dominate classroom questioning and discussions. There is compelling evidence in the literature of the benefits to students in relation to the construction of knowledge when teachers deliberately plan opportunities for students to participate in meaningful discussions and to ask and find answers to their own questions. What is not so obvious in the literature on classroom discourse, is research that looks in depth at the experience of individual students and the extent to which they are afforded or denied

opportunities to participate in classroom discussions, and the resulting effects this has on the way students report their experience of the classroom.

Integrated summary

In this literature review I began by outlining the socio-cultural and constructivist theoretical frameworks for my particular research focus within the Project on Learning. Four key themes were selected as the basis of the literature review because of their particular relevance to the classroom. I then described some of the empirical literature related to each of the themes, from which the following key ideas emerged.

In relation to teacher centrality, I gained a strong sense of the key role played by the teacher in the management of the classroom and in the provision of opportunities that either enhance or limit children's learning. The literature confirmed my suspicions (based on my own 25 years classroom experience) that due to the complexity inherent in teaching 30-35 students and a variety of other constraints on their practice, teachers are often unaware of, or simply do not see much of, what goes on in the classroom. Teaching is often based on intuition, assumptions and inherited cultures of practice. I also gained a strong sense of the difference between the rhetoric around constructivist principles of teaching and learning, and the reality of the limited application of constructivist praxis in the classroom.

The central role of the teacher emerged strongly also in the literature reviewed on classroom culture. Although the students may contribute to the establishment and maintenance of classroom culture, it is essentially the teacher's philosophy, classroom management practices, and planning of tasks that both creates, and in a sense dictates, the culture of the classroom.

The tasks and activities that teachers plan, and the ways in which they are implemented and managed are critical variables in relation to opportunities for student participation and learning. Consistent with constructivist principles, the need for students to be active participants in the learning process is well documented. However, in common with the previous two sections, the extent to which this is possible is dependent on the opportunities teachers provide for students to determine what and how they learn.

Classroom discourse is an integral part of classroom culture and the tasks and activities provided for students. From the literature it is clear that the discourse of the classroom influences the extent to which students can be active in the construction of knowledge. It is

also apparent that classroom discourse is still predominantly teacher-led, and in many instances, teacher dominated.

Underlying all of these ideas is a growing awareness of the uniqueness of the individual learner. The influence of socio-cultural factors on how an individual student experiences the classroom is now prevalent in the literature. As stated in my introductory chapter, as a teacher I spent 25 years attempting to meet the needs of my learners, without ever really understanding just how unique each student was. My own lack of awareness, and the constraints of time when trying to manage large classes of students, prevented me from having other than superficial knowledge of the impact on learning of a student's culture, prior knowledge, experience, abilities, and importantly their perceptions of this whole phenomenon of "teaching and learning".

The key ideas to emerge from this literature review have been used to ground my own study and will be used to illuminate my study while also examining ways they do not. The Project on Learning has afforded me the valuable opportunity to examine the complexity of the relationship that exists between teaching and learning. It is hoped that the following chapters of this thesis will capture the reality of the classroom experience for a group of students and their teacher, and in this way, contribute to the existing body of literature.

My own study seeks to expand on Nuthall's assertions by examining in-depth, the complexity of the relationship that exists between teaching and learning. The four themes selected as the basis for the literature review are central to my own study which examines the effects on learning of the teacher, the culture of the classroom, the tasks and activities students are given, and the discourse of the classroom.

CHAPTER 3

METHODOLOGY

Background and overview

This chapter includes details of the methodology used in all eight studies in the Project on Learning. The focus of the analyses will be on selected lessons from two studies only (studies 16 and 18). The term "subjects" will be used as a label for the four targeted students in each study, to distinguish them from other students that were in their classes.

The methodology employed in the Project on Learning comprises both qualitative and quantitative conventions, and is based on the established methodology of Nuthall and Alton-Lee (1992; 1993). The methodology is highly regarded by prominent educational researchers (Burns, 2000; A.B.Smith, 1998; Shuell, 1996). According to Shuell (1996, in Berliner & Calfee, 1996):

> The research methodology employed in these studies may serve as a model for the next generation of research on classroom teaching and learning that focuses on the relationship between teacher behaviour and student outcomes...Through the use of both quantitative and qualitative data, these studies provide useful insights into the way individual students acquire knowledge about specific content during classroom instruction. Not only do they capture the dynamic nature of classroom learning, but they suggest why certain classroom activities are either effective or ineffective and why particular students remember some things about the lesson but not other things (p.756).

Summary of data collection procedures developed by Nuthall and Alton-Lee

The methodology developed by Nuthall & Alton-Lee (1992; 1993) comprised the following data collection procedures:

- running record observations;
- audio and video taped recordings;
- pre and post-test related to content;
- extended interviews that explored the subjects' knowledge and thinking about the curriculum content and their feelings and beliefs about their learning experiences conducted approximately three weeks after the conclusion of the unit;
- further interviews conducted approximately six months and twelve months after the conclusion of the unit to test subjects' retention of content knowledge in the long-term memory;

- photocopies of all work produced by the subjects;
- photographic records of key resources used by the subjects.

The primary focus of Nuthall and Alton-Lee's research (1992:1993) and Nuthall's later classroom studies (1998) was on students' concept learning and memory. The data analysis and post-unit interviews conducted with the subjects primarily related to their understanding of the concepts embedded within the post-test items and their recall of how they learned the concepts. The chief result of the studies conducted by Nuthall and Alton-Lee (1992; 1993) is described by Nuthall (1999) as:

> ...the development of a descriptive model of the learning process as students encounter successive experiences in the classroom. From this model procedures have been developed based on an analysis of the content, sequence, and timing of content-relevant classroom experiences that can be used to predict the specific curriculum content that students will learn and remember twelve months later. The data suggest that even basic knowledge acquisition involves complex cognitive processes that are strongly shaped by the social processes and cultural structures of the classroom context (p.142).

Nuthall (1999) evaluated the data from his previous studies as follows:

> Although the data pertain to students' long-term memory for experiences, they do not shed light on how their learning experiences shape their learning...Another problem with our data is the relative lack of attention to the motivational and attitudinal aspects of the students' experiences. Before any analysis of the ways in which students learn is complete, it must incorporate a parallel analysis of the ways in which students acquire interests and attitudes (p. 250).

Expanding the analysis and the incorporation of additional data collection procedures in the Project on Learning

The study reported in this thesis is situated within the Project on Learning and as such is based on the methodology developed by Nuthall and Alton-Lee (1992; 1993). While this study has used the same data collection procedures as those identified on p.101, the additional contribution to the methodology and expanded analysis of the data delineate this study from the larger Project on Learning in the following ways.

1. Change of research focus

As a member of the Project on Learning research team, I still considered that an analysis of students' concept learning was critical to understanding the teaching-learning relationship. In addition, as a result of the team's many discussions of its observations from the first two studies, and based on the identified limitations of Nuthall's previous studies, it was agreed

that the focus of this thesis within the Project on Learning would be broadened to examine the significance of the following: the effects of the teachers' behaviour on the way that individual students experience the classroom; the importance of task design and management in relation to the opportunities provided for students to cognitively engage with and learn from tasks; the significance of the distinct phases of typical lessons in science and social studies; an analysis of the discourse of the classroom, and an examination of the unique ways that individual students contributed to and experienced the culture of the classroom. In addition, interview data on the teachers' and students' perspectives on teaching and learning was to be collected and analysed.

Professor Nuthall agreed that extending the research focus in these ways would be compatible with his aims for the project and would make a useful contribution to furthering understanding of the significance of aspects of the teaching-learning relationship that had not been a focus in his previous classroom studies.

2. Incorporation of additional student and teacher interviews

The content-related interviews conducted in previous studies by Nuthall and Alton-Lee (1992; 1993) and Nuthall (1998) were also conducted with all subjects in all studies within the Project on Learning. The content-related interviews were conducted by Professor Nuthall and myself.

In order to collect data on the teachers' and students' perspectives on teaching and learning, a comprehensive set of interview questions was developed for use in additional post-unit interviews with all subjects and the teacher in each study (see Appendices 4 – 8). The focus of the interviews was on the subjects' and teachers' perceptions of teaching and learning, their perceptions of classroom tasks, and a discussion of issues relating to a wide range of group and social processes that have been shown to impact the total classroom experience for students and teachers. This study was the only one to include this particular set of interviews.

Transcripts of the additional interviews conducted by Veronica and myself were made available to all researchers on the project, providing a richer source of data for analysis than had been collected in Nuthall and Alton-Lee's previous studies. A fuller description of all data collection procedures used in the Project on Learning follows.

Informing prospective schools about the Project on Learning

Two booklets containing information about the Project on Learning were prepared for distribution to prospective schools, parents, and Boards of Trustees. Similar in content, one of the booklets entitled "Project on Learning" was intended for the principal and staff, and contained more in-depth detail of previous classroom-based research studies, with examples of tasks that had been investigated. The other booklet was entitled "Project on Learning– Information for Parents". Written by the principal investigator, the booklets contained the following details of the Project of Learning.

- a description of the project;
- the questions of investigation;
- background information on previous research on learning and teaching, in particular those studies conducted as part of the Understanding Teaching and Learning Project conducted at the University of Canterbury;
- the research design;
- data collection processes;
- data analysis and the compilation of 'concept-stories';
- interaction with people involved in the project;
- reference list of research reports for additional information;
- details of the principal investigator and the two research assistants.

Obtaining permission from participants

Schools were given time to consider the information in the booklets before they were contacted by the principal investigator to ascertain their participation in the project. Once a decision had been to participate in the project, the school Principal provided the principal investigator with names of teachers who might have a special interest in being involved. Contact was made with the teachers and a preliminary meeting was held to discuss the project, and to invite the teacher to participate. Once the teacher had accepted, a letter was sent with the information booklet to the parents/caregivers requesting permission for their child to be included in the study.

Informing students about the Project on Learning

On receipt of permission from parents/caregivers for students to be involved in the project, the principal investigator arranged to visit the class to discuss the project with the students. The importance of being able to conduct research into learning and teaching in classrooms was highlighted. Data collection procedures were described, including the need to administer

pre and post-tests. Care was taken to emphasise the fact that students were not expected to know all the answers, and that the tests would not be graded. Issues of confidentiality were explained. This information-giving session concluded with opportunities for students to ask questions about the project and their involvement in it.

Description of participating schools

Three schools were selected for participation in the Project on Learning. The schools were all located within a ten-kilometre radius of the University of Canterbury. The schools varied in size and decile rating and included a large decile 6 suburban full primary school, a small decile 8 suburban contributing school, and a medium size decile 10 suburban contributing school.

New Zealand schools are given a decile rating from 1 – 10. A school's decile indicates the extent to which the school draws its students from low socio-economic communities. Decile 1 schools are the 10% of schools with the highest proportion of students from low socio-economic communities, whereas decile 10 schools are the 10% of schools with the lowest proportion of these students. Deciles are used to provide funding to state and state integrated schools to enable them to overcome the barriers to learning faced by students from low socio-economic communities. The lower the school's decile, the more funding they receive. Factors taken into account when calculating deciles include household income, parents' occupation, household crowding, educational qualifications of parents, and percentage of parents receiving income support.

The eight studies (numbered 11–18) were conducted over a two-year period (four studies per year). The first four studies were conducted in two different classes (Class 1 and Class 2) located in the same school (School A). Studies 15 and 17 were conducted in the same class (Class 3) in School B. Studies 16 and 18 were conducted in the same class (Class 4) in School C. Out of consideration for the teachers and students, the studies alternated between classes (in the case of school A) and between schools B and C.

Table 1 shows the decile ratings, approximate student roll numbers, and number of classes with a full time teaching staff member for each of the schools at the time the studies were conducted.

Table 1

Decile ratings, student roll numbers, number of classes in participating schools

School	Decile Rating	Student Roll Number	Number of Classes
A	6	450	18 (includes one satellite)
B	8	135	6
C	10	229	9

Description of participating classes

Class 1 (School A)

Studies 11 and 13 were conducted in a mixed ability Year 5 class.

Class 2 (School A)

Studies 12 and 14 were conducted in a mixed ability Year 6 class. Of interest was the composition of the class (18 boys, 9 girls).

Class 3 (School B)

Studies 15 and 17 were conducted in a mixed ability Year 5 & 6 composite class (School B).

Class 4 (School C)

Studies 16 and 18 were conducted in an ability streamed Year 5 & 6 composite class. Students who were considered to be of high ability were selected for inclusion in the class.

Table 2

Composition of participating classes and range of student achievement levels

	Class 1 Studies 11 & 13		**Class 2 Studies 12 & 14**		**Class 3 Studies 15 & 17**				**Class 4 Studies 16 & 18**			
	Boys	**Girls**	**Boys**	**Girls**	**Boys**		**Girls**		**Boys**		**Girls**	
Number in Class	17	16	18	9	Yr 5 7	Yr 5 6	Yr 5 6	Yr 6 10	Yr 5 4	Yr 6 14	Yr 5 8	Yr 6 4
Age Range	8.6- 9.7	8.6- 9.6	10.2- 11.3	10.3- 11.0	9.3- 10.1	10.2- 11.1	9.5- 10.3	10.1- 11.0	9.0- 9.11	10.1- 10.8	9.3- 9.9	9.9- 10.10
Ethnicity	Pakeha 15 Maori 2	Pakeha 16	Pakeha 15 Maori 1 Asian 1 Russian 1	Pakeha 8 Iraqi 1	Pakeha 8 Maori 2 Asian 3		Pakeha 11 Asian 2 Iaqi 2		Pakaha 15 Asian 3		Pakaha 11 Maori 1 Iraqi 1	
Range of Achievement Levels (class percentiles)												
PAT Reading Vocabulary range **Class Average**	15-94 56	11-95 63	7-97 54	28-98 63	22-69 41	14-69 44	4-97 49	9-85 51	31-99 71	49-85 60	76-99 78	57-96 68
PAT Listening Comprehension **Class Average**	23-99 71	10-92 60	24-95 65	30-98 77	19-56 44	37-96 68	4-97 41	2-96 48	16-91 72	53-96 68	36-99 65	50-76 62
Reading Age (Range)	7.5-13	8-13	7.5-14	8-14	8-10	9-14	8.5-13	9-14	8.5-15	10-15	8.5-15	10-15
PAT Maths (Range) **Class Average**	22-99 60	20-96 55	34-96 60	18-99 67	28-85 56	30-98 61	9-99 62	21-99 70	7-90 28	39-98 81	15-32 24	7-92 57

Composition of participating classes

Table 2 provides a summary of the following for each participating class:

- number in class
- gender composition
- age range
- ethnic composition
- range of achievement levels and class averages in progress and achievement tests (PAT) in reading vocabulary, listening comprehension, and mathematics
- reading age range.

The date shows a variation in the number of students in each class with a low of 27 in Class 2 to a high of 33 in Class 1. There are notable differences in the gender compositions in Class 2 and Class 4. In Class 2 there were twice as many boys than girls and a third more boys than girls in Class 4. The ethnic imbalance is evident in all classes with the majority of students being Pakeha. It is of interest to note the two schools with the highest decile ratings had the largest number of Asian students. There is an even spread of ages across the classes of approximately one year in the two single year level classes (Class 1 and 2) and a spread of approximately 18-20 months in the two composite classes (Class 3 and 4).

The spread of achievement levels in each class is significant. As demonstrated, the PAT reading vocabulary range and PAT listening comprehension range illustrate the wide variation in the levels of reading achievement, particularly in Classes 1,2 and 3. The spread in Class 4 is not so significant as this was an ability streamed class. The lowest scores of 31 and 16 in the Year 4 boys cohort was an exception as this student had been included in the class for management of his behaviour, not on ability.

In each class the spread of reading ages is similarly significant, with an average spread of 5 years and a high of 6.5 years across the 4 classes. The spread of PAT achievement levels in mathematics is similarly significant across all classes. Of interest is the relatively low average mathematics PAT scores of the Year 5 boys and Year 5 girls in Class 4, compared to the other three classes and to the Year 6 students in Class 4. The teacher of Class 4 commented that she had 'inherited' the problem from the previous year and that she would have to work very hard to get the students' scores up, as she had done the previous year with the current Year 6 students.

Table 2 provides evidence of the challenges faced by the teachers in providing programmes that cater for the spread in achievement levels that are common to many classrooms.

Selection of subjects

The principal investigator used a stratified random sampling procedure to select four subjects for each study. The objective was to include two high achieving students and two low achieving students in each sample. Criteria used for the selection of subjects were consistent across all studies. Each sample included equal numbers of boys and girls, with students from different ethnic groups represented (for example students from Maori, Middle Eastern and Asian ethnic groups).

Prior to selection, the teacher provided the researchers with a comprehensive set of information about all students in the class. This included a record of student achievement scores in a number of curriculum areas, and the students' reading ages. The scores were derived from the norm referenced Progress and Achievement Test (Reid & Ellery, 1991) and included the following:

- PAT reading comprehension;
- PAT listening comprehension;
- PAT reading vocabulary;
- PAT mathematics;
- PAT equivalent band reading age.

The PAT scores for reading, comprehension, listening, vocabulary and mathematics were averaged to obtain a mean PAT score for each member of the class. Teachers advised the researchers of any students who they considered to be unsuitable for inclusion in the sample. These included students with significant learning, emotional or behavioural needs, and those students with English as a second language. The subjects' identities were not made known to the students or the teacher until after the completion of the study.

This stratified random sampling method occurred twice for each classroom, resulting in two different sets of four subjects being selected for each individual study. Table 3 demonstrates the characteristics of the individual students who were observed and interviewed.

Table 3

Characteristics of the individual students observed and interviewed

Topic of Unit	Students (gender)	Age (years)	Year Level	Reading Age (years)
Study 11 Light & Colour	Ronnie (m)	9.10	5	9 - 10
	Dane (m)	9.30	5	10.5 - 11.5
	Lucy (f)	10.20	5	11 - 12
	Jude (f)	9.10	5	8 - 8.5
Study 12 Light & Colour	Charlie (m)	10.30	6	10.5 - 11
	Max (m)	10.30	6	11 - 12
	Kate (f)	10.30	6	10.5 - 11
	Hollie (f)	10.90	6	8 - 8.5
Study 13 Ancient Egypt	Bart (m)	9.10	5	9 - 10
	Justin (m)	9.60	5	11 - 12
	Nellie (f)	10.20	5	10.5 - 11
	Edith (f)	9.11	5	9 - 10
Study 14 Country of Origin	Todd (m)	10.20	6	11 - 12
	Tyler (m)	10.10	6	11 - 13
	Kathy (f)	10.11	6	11 - 12
	Harriet (f)	10.60	6	8 - 9.5
Study 15 Problem – Solving & Plans	Mike (m)	11.00	6	10 - 11
	Rhys (m)	10.10	5	9 - 10
	Kellie (f)	9.80	5	12 - 13
	Kitty (f)	10.20	6	10 - 11
Study 16 Kitchen Chemistry	Jeff (m)	9.50	5	12 - 13
	Jack (m)	9.80	5	8.5 - 9
	Beth (f)	9.60	5	9 - 10
	Elle (f)	9.90	5	11 - 12
Study 17 Space	Dion (m)	9.60	5	9 - 10
	Joseph (m)	11.00	6	12 - 13
	Lois (f)	10.10	6	12 - 13
	Abby (f)	10.30	6	9 - 10
Study 18 Aztecs	Ned (m)	10.50	6	10.5 - 11
	Rod (m)	9.40	5	13 - 15
	Rewa (f)	9.70	5	10 - 11
	Libby (f)	9.40	5	10 - 11

Development and use of printed tests

Developing a printed test

A printed test to measure concept learning was developed for each study unit by the principal investigator. Typically, the test would contain approximately 40 questions. The questions were based on all of the teacher's intended learning outcomes as discussed with the researchers during the initial planning meetings.

Thus, the tests included a mix of the following types of questions:

- multi-choice questions;
- open-ended questions which were written to ascertain the extent of student's knowledge about a particular concept;
- questions that probed student's specific knowledge and understanding of concept;
- questions that explored a student's prior experience of the concept;
- questions of a more general nature relating to student's perceptions of how much of the unit content they had understood, how much they felt they had learned, how interesting they had found the unit, how much they had enjoyed the unit.

Examples of each type of question included in the printed test

Multi-choice questions

Study 11, Item 36:

How long do you think it takes for the sun's light to reach us here?

- no time at all
- eight to ten minutes
- about a month

Open-ended questions to ascertain the extent of a student's knowledge

Study 11, Item 37:

The sun makes its own light. What else do you know that makes its own light?

Questions to probe specific knowledge about a concept

Study 11, Item 34:

Here is a colour shell with the three primary colours and three secondary colours in it. Write in the names of the missing colours.

Questions to determine a student's prior experience of the concept

Study 11, Item 32:

What do you see when a drop of oil is spilled on water?

Questions relating to students' perceptions of the unit

Study 11

When you did the topic on light and colour, did you find it interesting?

- it was all very interesting
- most of it was interesting
- only a little bit of it was interesting
- none of it was interesting.

How much of the topic on light and colour did you understand?

- I understood almost everything
- I understood some of it
- I only understood a little bit of it
- I couldn't understand any of it.

Which part of the topic on light and colour did you like best?

Which part of the topic on light and colour did you like the least?

What sort of activities would you like to include in a topic of this type if you had a chance?

Samples of printed tests are included in Appendix 8.

Administering the pre-test

Several days before the unit began, the printed pre-test was administered orally to the whole class by the principal investigator. Students were asked to wait until each question had been read out before writing their response. It was emphasised that the responses should be the student's own, and should be written without collaboration with peers. At the conclusion of the test, the test papers were collected by the principal investigator for marking purposes. The teacher did not see any of the students' responses.

Administering the post-test

The printed test was re-administered orally to the whole class within two weeks of the conclusion of the unit. The procedures and conditions were the same as for the administration of the pre-test.

Marking of the tests and recording the scores

The tests administered to students before and after the units were marked by the project manager. Scores were ranked and recorded for all students in the class. The results were not divulged to the teacher or students before or during the unit. Teachers were provided with the test results at the conclusion of the unit if they specifically requested them.

Audio and video recording procedures

Preparing the recording equipment

During the course of each study, continuous audio and video recordings were made of the subjects' behaviours and speech. At least one week prior to the commencement of the unit, the project technician installed the necessary recording equipment in the classroom, in consultation with the principal investigator. Six miniature video cameras were set up around the ceiling of the classroom. Four cameras were focused on the area surrounding the four subjects. Two wide-angle lens cameras were focused on the area surrounding the four subjects. Two wide-angle lens cameras covered the whole classroom from opposite corners of the room. Each camera was linked to a video-recorder and time-code generator. The time coders were checked and set daily and synchronised with the observers' stop watches to ensure accuracy of timing. New videotapes were used for each session. All tapes were identified by codes only.

Each student in the class had an individually named broadcast microphone to wear at all times during the unit. The microphones were attached to fabric bands designed for wearing around the neck. All microphones were identical in appearance and contained batteries. Only the four subjects' microphones were connected to the recording equipment. The teacher wore a small clip-on microphone that was also connected to the recording equipment. All microphones were collected and tested at the end of each session.

The video recorders and time-code generator equipment were positioned in the most appropriate available area of the classroom, as far away as possible from student working areas and foot traffic. The equipment was covered when not in use, and students were instructed that the equipment was not to be touched under any circumstances.

Trialing the equipment

All audio and video recording equipment was trialed prior to the commencement of the unit. A number of daily equipment checks were made prior to recording. The location of the cameras was checked to ensure maximum visibility. Observers discretely checked the position of the subjects' desks to ensure they had not been moved out of camera range.

Checks of the recording equipment were made to ensure all subjects' and the teacher's microphones were switched on and functioning correctly.

Familiarisation with equipment and classroom

Two to three days prior to the commencement of the unit, the students and teacher were familiarised with the presence and the purpose of the audio and video recording equipment. It can be expected that students of Year 5-6 age will show interest in and may become excited by the novelty of such equipment. For this reason, the students were given the microphones to wear during the familiarisation session. They were instructed on the preferred way to wear them (tucked inside their shirts or jerseys) to prevent the microphones from unnecessary movement or handling. Students were requested not to play with the microphones or to remove the batteries. The principal investigator also turned the wide-angle lens video cameras on to enable the students to see themselves on camera. Part of the familiarisation session was filmed and a short segment was shown to the whole class. This helped to establish trust and rapport between the researchers and students and assisted the students to feel comfortable with the equipment and recording procedures.

During the familiarisation period, the observers had the opportunity to do trial observations using the established behaviour codes. It was also an opportunity to become familiar with the subjects, the way in which students were grouped, and the general layout of the classroom. Observers were able to locate the most convenient and discrete observation points in the classroom.

Written observations during the unit

Continuous running record observations

Three or four observers (usually the principal investigator, the two research assistants, and the project manager) made continuous written running records of the behaviours, sources of information, and contexts for each subject throughout each session of the unit. Previously trained in classroom observation techniques by the principal investigator, the observers used a set of established behaviour codes to facilitate the recording of data. The consistent use of the codes also facilitated the subsequent transcription of data.

Observation recording sheets

Written observations were recorded on sets of recording sheets specifically designed for the Project on Learning. The front cover was used to record details of the daily tasks and lesson sequences. Observers included a summary of the context of the lesson (individual, group, whole class), a brief description of the task and summary of task content, and the main phases of the session/lesson, including the duration of each phase. In addition, any particular

incidents or student behaviours, including their approaches to the task and their coping strategies were recorded on the cover sheet.

In preparation for each observation session, the observation sheets had the time recorded in intervals of 30 seconds. One observer could record the behaviours of two subjects when required. In addition to recording the subjects' behaviours, one observer took responsibility for recording any information that the teacher may have written on the whiteboard that could possibly be erased before it could be photographed.

Photographs were taken and photocopies made of everything that the students read, looked at, wrote, illustrated, or made, including photographs of classroom displays of students' work or information displayed by the teacher.

Recording homework

At the beginning of each session, each student in the class was given a homework sheet to fill in. The students were asked to record any additional topic-related activities they had undertaken out of class time. The sheets were collected by the researchers for analysis. Compiled by the principal investigator, the homework sheet asked the students to record the following information (using as an example, the topic Space).

Sample homework sheet

Name:_____

Since _____ (Name of week day or Over the Weekend)

What I did at home about Space.

I read a book or magazine about Space
The book was from home
The book was from the library
I looked at pictures about Space
I used a computer to find out about Space
I wrote something about Space
I watched a television programme about Space
I talked about Space, or what we did in class to

My Mother
My Father
My Sister or Brother
My Friend
Someone else I know

Something else I did about Space

_____
_____
_____

Something I learned about Space

_____
_____

Teacher planning meetings and interviews

Meetings and interviews were conducted with teachers on at least four occasions for each of the eight studies. A description of the purpose and format of the meetings and interviews follows.

Initial meeting with participating teacher

An initial meeting was held in the term preceding each study. The purpose of this meeting was to establish a rapport and professional working relationship between the researchers and the teacher. Led by the principal investigator, the teacher was provided with information about the Project on Learning and was given the opportunity to seek clarification on any issues of interest or concern. The meeting was scheduled to last between 30–45 minutes and was held at a time convenient to the teacher. Meetings were conducted in either the teacher's classroom or in another available meeting space within the school. Due to the intentional informality of the meeting the discussion was not tape-recorded.

The researchers aimed to cover the following issues and matters of general interest in this meeting:

- to provide the teacher with general background information on the project;
- to familiarise the teacher with the aims of the project, and to emphasise to the teacher that the primary focus of the research was on the classroom experience of the students;
- general organisational matters relating to the data collection procedures;
- to emphasise the requirement to able to observe, film, and record all teaching and associated classroom activities and tasks related to the topic;
- ethical considerations;
- to provide reassurance of the confidentiality of the data;
- to request information relevant to the selection of subjects with a request for current class lists, dates of birth, and any information the teacher may have on individual students such as standardised test scores from Progress and Achievement (PAT) tests;
- to ask the teacher to identify any students who were considered to be unsuitable for selection as subjects;
- to request seating plans for placement of cameras and technical equipment;
- to request a class photograph for the identification of subjects;
- to provide the teacher with the opportunity to seek clarification on any aspects of the project;
- to obtain from the teacher, some indication of the proposed topic and duration of the unit.

Planning meeting

Approximately three weeks prior to the commencement of each study, a meeting was held with the teacher to discuss their planning and general organisation for the unit. Scheduled to last between 45-60 minutes, the main purpose of the meeting was to identify the expected learning outcomes for the unit, and the resources the teacher intended to use.

During this meeting the teacher discussed all relevant aspects of their planning for the selected unit. The teacher provided copies of any preliminary or completed planning documents along with any available resources for the researchers to duplicate for the purpose of developing a written pre-test for the unit. This meeting also provided the individual researchers with the opportunity to discuss the possible accommodation of any of their particular areas of interest into the teacher's planning. It should be emphasised that at no point were teachers made to feel any obligation to incorporate the researchers' interests into their planning.

Final meeting prior to the commencement of the study

This short meeting was held in the week preceding the commencement of the unit.

The purpose of the meeting was to discuss the following:

- final arrangements for the installation of the technical equipment
- observation timetables
- schedule for the administration of the pre-test.

Post-unit interview

At the conclusion of each study the author requested an interview with the teacher. This 45 - 60 minute post-unit interview was scheduled for the week following the conclusion of the unit. Permission was sought to tape-record the discussion for the purpose of transcribing. In preparation for the meeting, and to allow the teacher time for reflection, a list of possible questions and issues for discussion was compiled by the author and given to the teacher three to four days prior to the interview. The teacher was reassured of the right to decline comment on any of the questions or issues that they felt were inappropriate. Issues of confidentiality of data were discussed, with the teacher given reassurance that all transcripts would use code names only and that no teacher would be able to be identified in any documentation of interview responses.

The structure of this interview was consistent across all studies. The interview was designed to be relatively open-ended, beginning with more general questions relating to the teacher's perceptions of the unit. Questions were grouped under the following headings:

- planning
- task effectiveness
- changes and adaptations to tasks and planning
- perceptions of students throughout the unit
- independent work
- student decision-making

- group work
- monitoring of students during independent task
- constraints on practice
- additional comments or issues.

The teachers in studies 13,14,15,17 and 18 had provided their students with opportunities for conducting independent research within the unit. Additional questions that specifically relate to issues of task design and management when students are permitted or expected to work on independent research projects were incorporated into the teacher interviews for these four studies.

Copies of the post-unit interview questions for teachers are included in Appendices 1-7.

Planning and conducting student interviews

At the conclusion of each unit, a series of tape-recorded interviews was conducted with individual subjects. The importance of understanding learning from the students' perspective was stressed in the information booklet distributed to all participating schools and parents/care-givers. "It is a very important principle of our research that we understand learning through the eyes of the children themselves. We need to know how they personally experience and understand their own and each other's activities before we can understand how their learning occurs" (Nuthall, 1998a, p.5).

Establishing trust and rapport between interviewers and subjects

Many students of this age have not experienced individual interviews of this type. The interviewers were aware of the fundamental need to establish rapport and trust between interviewer and subject, and to develop the subject's confidence and sense of security in an interview situation. Within the Project on Learning, this process was facilitated due to the fact that the interviewers were known to the students, having spent the previous three or four weeks observing in their classroom. Each student participated in a minimum of three individual interviews. In order to minimise the need for students to relate to several different interviewers, it was considered important that only one interviewer would be present at any given time, and that any one student would be interviewed by a maximum of two different researchers during the course of the interviews.

Prior to any interviews being conducted, the students were given assurance that the interviewer was interested in finding out how they learn in class and not whether their answers were right or wrong. Students were made to feel that they were able to control the interview process. The interviews were scheduled to suit the student and class timetable.

Where possible, students were able to nominate preferred times for the interviews to be conducted. The teachers were extremely accommodating with regard to the time required to conduct the interviews, and were supportive of the students being able to nominate their preferred time to be interviewed, even if this meant missing out on curricula activities. Students were advised of their right to decline to answer any of the questions.

Issues of confidentiality were discussed with the students. Interviewers requested permission to tape record all student interviews. Students were advised of their right to decline to answer any of the questions. Students were reassured that their responses would be kept strictly confidential, and that the only people who would hear the tapes and read the interview data would be the researchers involved in the project, and the personnel responsible for transcribing them. The use of the coding system to ensure anonymity was explained to the students to demonstrate that they would not be able to be identified from the interview transcripts.

Interviews were conducted in available spaces throughout the school, during normal teaching times. Consideration was give to seating arrangements, with the interviewer seated beside the student to minimise formality and any impression of authority. The door of the interview room was kept open at all times. Each interview was designed to last no longer than forty-five minutes. This was considered to be a realistic period of time for students of this age to be able to remain focussed. The exception to this time frame was the video-stimulated recall interviews, which ran for longer periods if students requested additional opportunities for discussion. Care was taken not to interview students during their morning breaks or lunchtimes. Students were able to request to terminate the interview if they felt fatigued, or if they wanted to rejoin the class for any special activities.

Schedule and description of student interviews

Each student was interviewed on at least three separate occasions. The first two interviews were conducted as soon as possible after the administration of the post-tests and were conducted by the same interviewer. The researchers aimed to complete all interviews within three to four weeks of the conclusion of the unit.

Description of student interviews

Post-test interview to determine understanding of test-item content

The outcome test was administered a second time from one to three weeks after the completion of the unit. During this interview an unanswered copy of the test was placed open in front of the subject. The interviewer worked through each item questioning the subject about their understanding of the test-item content and their memory for relevant classroom

experiences. For each item in the test, each student was asked to describe the correct answer, to recall how he/she had learned that answer, and to recall any activities that were relevant to the answer. The interviews began with the interviewer explaining that he or she was interested in finding out how students learned in class. The interest was not in whether their answers were right or wrong, but in how they were thinking about and learned the answers.

Because of the length and complexity of the interviews a fixed format was not followed. Typically, the questions asked for each item were:

- How did you learn (know) that? Where did you learn that?
- Do you remember that coming up in the unit? Was there anything said or done about that in the unit? Where would you have seen (heard about) that?
- Did you know that before the unit? Did you learn that during the unit?

Probing questions were used with each test question until the student's recollections had been exhausted.

The interviewer did not attempt to correct any misconceptions that the subject may have had. Value was given to all of the subject's responses and the interviewer only offered correct answers or additional information if the subject specifically requested it. If the interviewer considered that the subject was tired or lacking in concentration, the interview would be terminated early and a further session scheduled. Generally two item-content interviews were required for each student.

Interviews to determine student perceptions of classroom tasks and related activities

This interview gave the author the opportunity to question subjects about issues specifically related to their perceptions of classroom tasks and activities, and about more general issues related to their wider classroom experience. Interviews were held with individual subjects and were scheduled to last approximately 45 minutes. As with the first interviews, students were reassured that there were no right or wrong answers. The interviewer explained that she/he was interested in students' thoughts and experiences about learning and teaching, and that this valuable information could be used to help teachers in their work.

The interviews were planned to be relatively open-ended, beginning with more general questions and ending, where appropriate, with more specific and probing questions.

Questions were grouped under the following five main headings:

- Tasks and activities related to the actual unit
- Working in groups
- Memory and ways of remembering

- Choice
- Advice to teachers and general issues related to the classroom experiences of students of this age.

Interview questions were consistent across all studies and related to the following issues of working in groups, memory and ways of remembering, choice, advice to teachers and general issues related to classroom experience. Questions related to the specific tasks and activities differed to match the specific content of each unit. The interview formats used in studies 16 and 18 are included in Appendices 6-7.

Interviews using video-stimulated recall techniques to determine the influence of mood and/or emotion on children's learning and task engagement

The third interview was conducted by one of the researchers in the project who had a particular interest in the influence of mood and/ or emotion on children's learning and task engagement. The purpose of this interview was to use a video-stimulated recall technique with the subjects to determine the unique ways individuals experience the classroom, and how emotion system responses influence children's task engagement and other responses in the classroom.

In preparation for the interview, the interviewer used two main sources of data. Videos of classroom sessions were scrutinised in order to isolate specific instances of interest for discussion with the subject. The interviewer also used information from the mood slips on which the subjects had recorded how they were feeling at a specified time during a session.

Prior to any discussion of events on the video, the interviewer assured the students of the confidentiality of their responses and that the only people who would have access to the videos were the researchers and the transcribers. The students reported to be enthusiastic about their participation in this type of interview. As a result, some video-stimulated recall interviews lasted up to 90 minutes. The interviewer transcribed interview responses.

Transcribing, coding, and collating data

The recorded and observational data for each study was transcribed, coded, and collated for analysis. A description of each process, including examples drawn from the data, follows.

Transcribing the data

The recordings made during each observation session were transcribed and copied onto data files by trained personnel. These were supplemented with observers' notes and copies of

everything the subjects were seeing, reading, writing, or illustrating. The recordings of the interviews with teachers and students were also transcribed.

Transcribed data from the observation sessions was organised into intervals of 15 seconds duration. For example, the transcript for a session of 60 minutes duration would contain 240 fifteen seconds intervals, providing a full record of each subject's unique experience throughout the session. The following detail was included in each transcript:

- number of the study;
- day of the study on which the observation occurred;
- the time;
- interval number;
- context (whole class, group, individual);
- all recorded utterances (subjects, teacher, other students within recording range);
- students' behaviours;
- teacher involvement.

Example of one 15 second interval of a typical transcript

The following 15-second interval taken from a transcript of the session conducted at time 2.03.00 on Day 6 of Study 16, demonstrates the format and type of information recorded on a typical transcript.

Study 16	Day 6	Whole Class	Time 2.03.00	No:31
Teacher:	Anyone remember the scientific name for baking soda? A or A?			
A or A:	Sodium carbonate?			
Teacher:	Almost! You missed out little letters before the carbonate.			
Pupil:	Ohh!			
Pupil:	Sodium Chloride?			
Teacher:	No			
Beth	Jeff	Elle	Jack	
WT	WP (source)	WT	WT	
		H	H briefly	
		WP (source)	TS – B.P. Oh. W around	
		TS – Ohh!		

Coding the data

The principal investigator trained the research assistants to code the transcripts for content (relevant to the curriculum outcomes of each unit), and for behaviour. The following three separate sets of codes were used to classify the data:

- Content codes used to classify the relevance of information.
- Behaviour and resource codes for observing individual students' behaviour. This set of codes included the classroom context (whole class, group, or individual), student behaviours (e.g., picture, whiteboard).
- Codes for categorising teacher and student behaviour in-group activities (e.g., teacher gives instructions at beginning of activity to whole class, socially interactive interpretation and organising).

Content codes used to classify the relevance of information

- Explicit item answer;
- Implicit or partial item answer;
- Additional information or explanation;
- Preparatory and contextual information;
- Mention only of keywords or synonyms;
- Activities and procedures;
- Instructions for relevant activities;
- Visual resources available but not the focus of activities or discussion.

Within each of these eight categories there was further differentiation as demonstrated in the following examples of categories 1 and 2.

- Explicit item answer;
- Exact item answer;
- Approximate item answer;
- Wrong or misleading answer;
- Implicit or partial item answer;
- Answer is logically implied;
- Significant parts of a complete answer;
- Corrections and information about what the answer is not.

This differentiation enabled coders to code the data in an explicit manner.

A full list of the content codes is included in Appendices 1-3.

Using the content codes to classify relevant information

The following example is provided to demonstrate the procedure used to classify relevant content information.

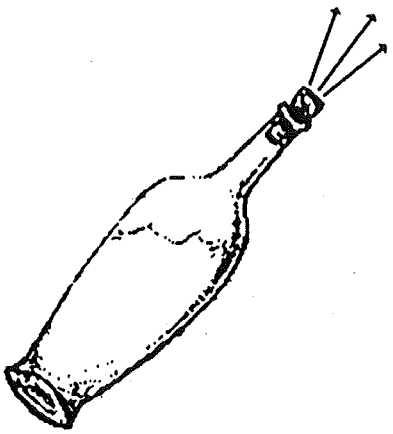
In Study 16, the students were involved in a unit entitled Kitchen Chemistry. A significant amount of the unit content related to reactions that may occur when an acid and carbonate are mixed together. The students were given a number of tasks and experiments to carry out that were designed to demonstrate these effects. One such task required students to make "chemical pop-guns". Students mixed together an acid (vinegar) and a carbonate (baking soda) in a plastic soft drink bottle. A cork was placed in the bottle. If the experiment had been conducted correctly, the build up of pressure resulting from the reaction of the acid and carbonate would cause the cork to eject from the bottle.

In order to apply the content categories, the information the student encountered in an activity or episode was first summarised as a single proposition or paraphrase. Each paraphrase was about some object, activity or concept related to an outcome-test item. When a student encountered and interacted with information needed to answer an outcome-test item, that information was coded according to the relevant category.

Baking soda and vinegar mixed together in optimum quantities make carbon dioxide. When this occurs under pressure, the force is sufficient to cause a cork to eject from a bottle. The more carbon dioxide that is produced, the greater the pressure. When too much of one ingredient is added (either an acid or a carbonate), saturation will occur.

Test item 23 related directly to the concept.

Item 23: What makes the cork pop out of the bottle?



Mixture of vinegar and baking soda

The information needed to answer item 23 is: the pressure caused by the carbon dioxide as a result of mixing an acid (vinegar) and a carbonate (baking soda). If a student had heard this exact information during a discussion between the teacher and class, or had been actively engaged in conducting the experiment and had observed or discussed the effects of the build up of pressure, the encounter would be coded in Category 1 (explicit item answer).

Category 2 (implicit or partial item answer) was used when the answer to a test item could be logically inferred from information the student encountered (2.1 answer is logically implied), or when the information encountered was part of the information required to answer the question (2.2 significant parts of a complete answer). For example, in relation to item 23 above, during intervals 145 – 148 on Day 5 of the unit the teacher stated, "We know that if we put baking soda and vinegar together that they react and give off carbon dioxide." This statement contained partial information required to answer the question and would be classified as 2.2 (a significant part of the required information).

Category 3 was used for a variety of different types of information that were relevant, but additional, to the knowledge required to answer a test item. For example, discussions relating to the optimum point and saturation, while not directly related to the test item, would be classified as 3.2 (background and related information) or 3.3 (reasons and explanations).

Any specific student experience or activity might be coded for several different items. For example, the following statement was made by a student during a class discussion during time interval 13: "An acid, vinegar, and a carbonate, baking soda put together form carbon dioxide." This information would be classified as 1.1 (exact item answer) in the concept-file for test item 19 where students were asked to write the name of the chemical produced when an acid and a carbonate are mixed. It would also be classified as 2.2 (partial item answer) for test item 23 where students were asked to explain why the cork popped out of the bottle.

Creating concept-files

The coded data was then compiled into detailed concept files for each subject. This procedure is described by Nuthall (1999, p. 148-149).

> Because the initial focus was on how students acquired the knowledge that made up the curriculum outcomes of each unit, the coding of the data began with the creation of concept files. For each concept, proposition, principle, or procedure assess in the outcome test, a "concept-file" was created for each student that contained records of all experiences that were related in any way to that concept, principle, or procedure. Each concept file was then analysed to identify the information content, sequence, timing, and other significant characteristics of the relevant experiences. This was done by coding every encounter the student had with relevant information on the basis of its information content (complete item answer, part of an answer, reason, analogy), source (teacher, book, other student), medium (spoken, heard, read, seen), function (asks question, responds to question, makes joking remark), context (whole class, small group, individual activity).

Behaviour and resource codes

A set of Behaviour and Resource codes was developed to enable the classification of the context in which the students were operating, the behaviours exhibited by the students, and the resources being used. The following three codes were used to describe the context:

C	whole class
G	group
I	individual

Up to 26 codes were used for recording and classifying behaviours. Examples include:

LT	listening teacher
LP	listening pupil
TT	talking teacher
H	hand raised
Y	yawning, bored, sleepy
F	fiddling
TP	talking peer
TS	talking self

Examples of codes used to classify resources include:

Mic	Microphone
Pic	Picture
Q	Question
T	Teacher
Bk	Book
Wk	Work, Worksheet, Instruction Sheet

A full set of behaviour and resource codes is included in Appendices 2-3.

Categories of behaviour in whole class and group activities

A third category system was developed to classify the students' behaviours during assigned group activities. There were six main categories developed for this purpose. Four categories (A, B, C, E) relate to the four main components of a typical classroom task undertaken by year 5 and year 6 students in science or social studies. These categories included:

A	Getting and clarifying instructions
B	Interpreting instructions and getting resources
C	Carrying out the procedures required by the instructions
E	Writing the report

Two further categories (D and F) were included to cover non-task related behaviours.

D	Social interaction unrelated to task procedures
F	Spending time doing nothing active

Within these categories, the behaviours were further divided up into those that were done individually, those that were done interactively with other students, and those that were done interactively with the teacher. These further divisions are demonstrated in the following example of the divisions within Category B, used to classify student and teacher behaviours relating to the interpretation of instructions and organising resources.

Category B:

- Interpreting instructions and organising resources;
- Socially interactive interpretation and organizing;
- Mutually co-operative interpretation and organization;
- Debate and negotiation of interpretation and organization;
- Negotiating the exchange of resources;
- Organising other children to organise resources;
- Organising who should work with who;

- Asking other students for help in organising resources;
- Interacting with teacher about finding or organising resources;
- Asking the teacher to help find resources;
- Getting help from the teacher to find or organise resources;
- Individually getting, arranging resources.

The full list of categories of behaviour in whole class and group activities is included in Appendix 3.

Coding sheets

Two separate coding sheets were designed for recording the coded data. One coding sheet was used to code the subjects' behaviours when working individually or in a group. The other coding sheet was used to record all four subjects' behaviours in a whole class context. A description of the coding sheets follows.

Coding sheet for group and individual behaviour

The group and individual coding sheet was used to code an individual subject's behaviour when working in a group or individual context. There was provision for up to three behaviours to be recorded for each 15-second interval. The item number(s) were recorded, followed by the code that best described the student's behaviour during that interval. The final column was used to record the teacher's behaviour. There was provision at the side of the sheet to record any additional comments or items of interest to the coders as they worked through the transcripts, and that may be useful for further data analysis.

Example of a group and individual coding sheet

The following example demonstrates the use of a group and individual coding sheet to record Jack's behaviours over two consecutive fifteen second intervals (numbers 79 and 80) on Day 6 of Study 16. Using the transcribed data from two consecutive fifteen second intervals (79 and 80) on Day 6 of Study 16, the following example demonstrates the use of a group and individual coding sheet to code Jack's behaviours.

Transcript of two consecutive fifteen second intervals on Day 6 of Study 16

Study 16, Day 6	Group	Time 2.15.00	No: 79
Teacher: Yes, you can use that. That's fine.			
Beth	Jeff	Elle	Jack
TP Mira – About up To here or just in That part? LP Mira – Just in That part. TP Mira – To budget. (on label) OK.	TPs – Oh, disgusting. LP – (inaudible) TPs – It just tastes disgusting is right. smiles	Fills jar	LP – Yeah. I know where it is. TP – It's says it on the glass anyway. TP – Oh, don't take the stuff out of … Oh. LP – That's all

Study 16, Day 6	Group	Time 2.15.15	No: 80
Teacher: You can use that. That's fine. Remember about three quarters. Yeah, That's fine			
Teacher: All right. My suggestion is that you put			
Beth M to get water from sink LP – That's about three quarters	Jeff TP's It tastes disgusting. It smells disgusting. LP – And it is disgusting. TP Rod – I suppose that it is good for making pop guns and stuff. Holds up bottle Rod tries to grab it TP Rod – That's a lethal weapon, a pop gun.	Elle LP – A bit more out Elle. TP – That's about three quarters. OK? Now go. M back to group	Jack LP girl – (inaudible) cause you Boys'll just Take over. TP girl – You're witches. LP girl – (inaudible) TP girl – Yes LP girl – sniggers

When analysing this section of transcript, it can be seen that at time 79, Jack is involved in a conversation with a peer (TP, LP). The boys are discussing the Dancing Raisins experiment they are carrying out. This behaviour is coded B1 (B= Interpreting instructions and organising resources, 1=Socially interactive interpretation and organising). The concepts embedded in the experiment relate to test item 19. As the teacher is involved in giving instructions during the activity, her behaviour is coded A2 (A= Getting and clarifying instructions, 2=teacher gives instructions during activity). Jack's behaviour changes at time 80. The teacher has stopped giving instructions and has moved out of camera range. Jack continues to talk to his peer, but the conversation changes from being content-related (B1) to making inappropriate comments to some of the girls in his group. Jack sniggers and states, "Boys will take over. You're witches". Because Jack is still engaged in organising the group's resources, this behaviour has been coded C9 (C=Carrying out the procedures required by instructions, 9=Engaging in social interactions unrelated to task procedures. His behaviour would have been classified as a D category (D=Social interactions about unrelated topic within group).

Applying the coded data to the group and individual coding sheet

The data relating to Jack's individual experience of the thirty seconds of the session is recorded on the coding sheet as follows.

Study 16 Group and Individual Child: Jack Page No.1									
Day	Time	Beh 1	Beh 2	Beh 3	Item	Code	Item	Code T	Comments
6 6	79 80	TP TP	LP LP	 Sniggers	19 19	B1 C9		A2	Boys will take over. You're witches.

Whole Class coding sheet

The whole class coding sheet was used to record the subjects' behaviours in a whole class context. The coding sheet enabled two behaviours to be recorded for each subject. The item number(s) that the whole class discussion or activity related to were recorded. The column headed 'Code' was for recording the activity the class was involved in. In addition, the coders frequently noted on the side of the coding sheet, any comments or behaviours of interest for later reference.

Example of a Whole Class coding sheet

The following example demonstrates the use of a whole class coding sheet to record the behaviours of the four subjects during two consecutive intervals (numbers 32 and 33) on Day 6 of Study 16.

Study 16	Day 6	Whole Class	Time 2.03.15	No:32
Pupil:	Sodium			
Teacher:	Lorraine?			
Lorraine:	Um, sodium bicarbonate.			
	(T writes sodium bicarbonate on whiteboard)			
Teacher:	That's right. Just seeing if you can remember. All right. Two Tablespoons of baking soda or sodium bicarbonate and six Raisins.			
Beth	Jeff	Elle	Jack	
WT WWB	WT WWB G Lorraine	TS – Ohh, ohh! WT H	WT WWB TS – Bi.....	

Study 16	Day 6	Whole Class	Time 2.03.30	No:33
	(T writes 6 raisins on WB)			
Pupil:	(laugh)			
Teacher:	Now.....			
Pupil:	Miss H?.			
Teacher:	Yes?			
Pupil:	That means we don't make (the chemical pop guns?).			
Teacher:	No. I haven't said that. We're going to do that afterwards. We're Going to do this one first. What you need to do.....			
Jack:	Make it really fast.			
Beth	Jeff	Elle	Jack	
WT WWB	WT WWB yawns fidgets	W around	WT WWB laughs calls out	

In this thirty seconds segment of the instructional phase of the session, the teacher is giving the students instructions for carrying out the Dancing Raisins experiment. At time 32 she intersperses the instructions with some revision related to the scientific name for baking soda. This discussion has been coded C5 (C5=Talking with the teacher about observations and results). The related test item is Item 19. At time 33 the teacher continues to give verbal instructions while simultaneously writing the instructions for carrying out the experiment on the whiteboard. Time 33 is coded A1 (A=Getting and clarifying instructions, 1=Teacher gives instructions at the beginning of the activity to the whole class).

From the coded data of the subjects' behaviours, it can be seen that Beth was presumed watching and listening for the full 30 seconds. Jeff was presumed watching and listening for the first 15 seconds, spending the last 15 seconds yawning and fiddling. Elle was fully engaged, presumed watching and listening throughout. In addition she raised her hand in response to the teacher's questions and saying the answers to herself. Jack was also fully engaged. In the preceding two intervals, Jack had raised his hand to respond to the teacher's questions. When not selected to respond he said the answer to himself. It should be noted that on Day 5 of the study, half of the students who had not been able to make the popguns were disappointed, despite the teacher's reassurance that they would be able to make them the

following day (Day 6). At time 33 one of the students asked the teacher when they would be able to make the popguns. The teacher stated they could make them after the dancing raisins task. Jack demonstrated his excitement by spontaneously calling out "Make it really fast". Clearly Jack wanted to complete the dancing raisins experiment as quickly as possible in order to make the popguns.

Applying the coded data to the whole class coding sheet

The data relating to the experience of the four subjects in a whole class context is recorded on the coding sheet as follows.

Study 16		Whole Class			Page No. 1				
		Beth	Jeff	Elle	Jack	Item	Code	Item	Code
Day	Time	Behl Beh2	Behl Beh2	Behl Beh2	Behl Beh2				
6	32	PL PW	PL PW	H TS	TS PW	19	C5		
6	33	PL PW	Yawn fiddle	PL PW	PL Calls Out	19	A1		

Collating the data

On completion of the coding of the lesson content and subjects' behaviour in each session, specific behaviours of interest were tallied. Examples have been selected from Day 5, Study 16, to demonstrate the use of the coded data to analyse and measure the extent of a range of subjects' behaviours including the following:

- Task engagement and other behaviours in a 19 minute group activity;
- The number of content and non-content related utterances made throughout the 49 minute session;
- The number of times subjects raised their hand in both whole class and group contexts during the 49 minute session.

Table 4

Individual subjects' behaviours during a 19 minute group experiment task within a 49 minute science lesson

Time in 15 Second Intervals	Total Intervals	Total Minutes	Individual Subject Behaviours			
			Beth	Jeff	Elle	Jack
63 – 74	12	3	Attending to T Yawn x 2 Hand up x 1	Attending to T Yawn x 1	Attending to T Fidgeting Slapping x 6	Not Attending Talking to peers
75 – 95	21	5.25	Watching another group's p.g experiment	Active/involved In group (p.g.) Instructs Predicts	T with group 1 min Active/involved (p.g.) Watches another group 2 minutes	Filling water Trough in prep for boat experiment
96 – 106	11	2.75	Attending to T	Attending to T	Attending to T Hand up whole Time (x11)	Continues to fill trough until 100 Attends to T Hand
107 – 138	32	8	Watching p.g Experiment	Active/involved In p.g Experiment	Active/involved in p.g Experiment	Plays with water at trough .75 min Starts own p.g. Experiment 1.25 minutes Active/involved In another group's p.g. experiment for 4.25 minutes Engages with own Group 1 minutes
Total	76	19				

Task engagement and other behaviours in a 19 minute group activity

The initial step in the analysis of subjects' engagement and other behaviours involved summarising each subject's behaviours during each segment of the lesson they were expected to be working in a group. It was common for group tasks to be interspersed with teacher instructions, discussion, or demonstrations to the whole class. For example on Day 5, Study 16, a total of 5.75 minutes (30.27%) of the 19 minutes allocated to carrying out the group task was taken by the teacher for instructional or discussion purposes. This necessitated the identification of each discrete segment of group work and recording the time intervals and duration of each segment in minutes. A summary of each subject's behaviours, including number of instances of a specific behaviour (e.g. hand raising) during each segment was then entered as demonstrated in Table 4.

From this summary it was possible to calculate the percentage of time the subjects were engaged in the 19 minutes scheduled for the group experimental task as demonstrated in Table 5.

Table 5

Percentage of time engaged by the subjects in a 19-minute period (actual time of 13.25 mins) scheduled for group experiment tasks.

Subject	% of 19 mins engaged in own group activity	% of 19 mins engaged in observing another group's experiment	Total% of 19 mins engaged	Total % of 13.75 of 13.75 mins
Beth	Nil	13.25/19 69.73%	69.73	100%
Jeff	12.25/19 64.47%	1/19 5.26%	69.73	100%
Elle	11.25/19 59.21%	2/19 10.52%	69.73	100%
Jack	1/19 5.26%	4.25/19 22.36%	27.62	39.62%

Context and relevance of utterances by subjects during the full lesson

Table 6

Number of 15-second intervals during which subjects made utterances in both whole class and group task contexts during a 49-minute science lesson

Context	Beth		Jeff		Elle		Jack	
	Content	Unrelated	Content	Unrelated	Content	Unrelated	Content	Unrelated
Talking to Teacher	0	0	3	1	6 (1 call out)	0	8 (4 call outs)	5
Talking to peers	0	1	23	13	20	6	32	55
Talking to self	0	0	3	0	0	0	14	10
Total Intervals	0	1	29	14	26	6	54	70

The figures in Table 6 indicate the number of time intervals during which the subjects made utterances, and may include more than one utterance in each 15 seconds interval. "Call out" indicates that the subject has made a spontaneous public utterance. Content-related utterances are those in which subjects respond to or participate in discussion of any concepts related to the lesson content. Non content-related utterances may be related to organisational or social discourse. The totals above demonstrate the considerable differences in the subjects' utterances. Jeff and Elle made content-related utterances at a similar rate. Beth made no

content-related utterances, and spoke to a peer once only in 49 minutes. Jack made content-related utterances at approximately twice the rate of Jeff and Elle. His rate of non content-related utterances was 50% higher than his own content-related utterances, and almost three times the rate of other subjects' non content-related utterances.

Summary of hand raising behaviour during the 49 minute lesson on Day 5, Study 16

Table 7

Number of times subjects raised their hands in both whole class and group task context during a 49-minute science lesson

Context	Beth		Jeff		Elle		Jack	
	Content	Unrelated	Content	Unrelated	Content	Unrelated	Content	Unrelated
Whole Class	0	3	2	3	10	4	15	3
Group	0	1	3	1	3	3	2	2
Total	0	4	5	4	13	7	17	5

Table 7 demonstrates the number of times subjects raised their hands in both whole class and group contexts during the full lesson. Throughout the lesson, subjects raised their hands at differing rates. The non content-related occasions were generally in response to teacher management strategies and general organisation. Frequently the teacher would request the whole class to demonstrate their attentiveness by stating "Hands up if you can hear me." During the lesson the teacher stopped the students on 47 separate occasions in order to gain their attention. Not all students responded to each request, hence the range of responding rates in Table 7. It may be concluded that this was not a successful strategy for gaining the students' attention.

It can be seen that Beth demonstrated no hand raising related to content. Compared to Jeff, both Jack and Elle had approximately twice the rate of hand raising behaviour in content-related contexts. It is of interest to note that further analysis showed that the teacher selected Elle to respond on five of the ten occasions she raised her hand in response to content-related questions. In contrast, Jack was selected only once out of the fifteen times he raised his hand in content-related contexts. Such data raises issues related to opportunities for cognitive engagement with concepts and to demonstrate knowledge in the public forum of the classroom. This in turn raises further issues related to the impact of such opportunities in other areas, for example, a student's social status within the class.

Ethical considerations

The principal investigator obtained ethical approval for the Project on Learning from the University of Canterbury Ethics Committee. Ethical procedures followed in the Project on Learning were similar to those of previous classroom based research projects conducted by the principal investigator, Nuthall and his colleague Alton-Lee (1992; 1993). Snook (2000 in Davidson & Tolich, 2000) considers that Nuthall and Alton-Lee's ethical procedures provide researchers with an example of good ethical practice, concluding "If only all researchers were as sensitive to the rights of young children" (p.75). In particular, Snook commends the way in which Nuthall and Alton-Lee negotiated the use of microphones with teachers, parents and the students themselves. The children were required to give their consent and at all times were in charge of their individual microphone, with the right to turn it off at any time to preserve their privacy. The offer was also made for any students who wanted to opt out of sessions that were being video taped to be given equivalent lessons in another place.

Application of ethical principles in the Project on Learning

The following ethical principles were applied to all studies and adhered to at all times during the Project on Learning.

Informed consent

Permission forms were sent to all parents/caregivers to be considered, discussed with the students, signed and returned to the teacher. The permission slip outlined the procedures that would be used, including the observation and recording of the learning activities in the classroom, and the fact that some children would be interviewed about what they understand and remember. It should be noted that no parents/caregivers or students declined to participate.

Right to withdraw

Preliminary meetings were held with teachers to inform them of the recording and observation procedures. Teachers were assured of their right to withdraw from the project, to request that sessions were not recorded, to decline to respond to interview question, or to turn off their microphone at any time.

Preservation of confidentiality and anonymity

The students and teachers were guaranteed absolute privacy and that their name and identifying details (including those of their school) would not be made known to others or be able to be identified verbally or in written or published reports. Codes that did not identify individuals or schools were used on all written data including the observation sheets and

samples of students' work. Observation sheets were securely attached to a folder that was kept closed when not in use. All audio and videotapes were coded. Two observers ensured that all written and recorded data were removed from the classroom at the end of each session. All data was securely stored in University premises in locked filing cabinets, accessible only to the researchers, the Project Manager, and research assistants. All recorded data will be destroyed when the researchers have no further use for it.

Right to feedback

Participating teachers were offered access to observation records, interview transcripts, and students' pre and post-test results. All teachers expressed an interest in having copies of the students' pre and post-test scores. The teachers were also advised that they would be able to access copies of the completed theses at the University of Canterbury library.

Cultural sensitivity

Snook (2000, in Davidson & Tolich, 2000) proposes that researchers are part of a changing social system, and should therefore attend to the evolving understanding of ethical principles in a particular society at a particular time. According to Snook:

> Researchers in New Zealand must be aware of cultural sensitivities, the Treaty of Waitangi, and gender disparities between researchers and their subjects. This cultural sensitivity is not an additional moral principle. It is simply the recognition that basic principles (like respect for others) have constantly to be applied in new ways (p.78).

Researchers in the Project on Learning demonstrated cultural sensitivity and were inclusive of all students at all times. Care was taken to select subjects from the range of cultural groups represented in each class. Interviews were conducted sensitively and with regard to the subjects' backgrounds.

Bias, objectivity, and honesty

Observer bias was minimised by ensuring that the researchers observed different subjects each session. The exception was when a particular task or activity was carried over into another session and the observer requested to continue their observation of a subject until the completion of the task. The researchers aimed to be objective in their coding and analysis of data through triangulation of observed and recorded data, and inter-coder reliability.

While it may not be possible to interpret research in a totally unbiased way, Snook (2000, in Davidson & Tolich, 2000) argues that it is possible to interpret it honestly. Researchers on the Project on Learning were honest in their communication with students and teachers at all times, and made every attempt to interpret the data honestly. The writer concurs with Snook that

> "Research is the search for truth and commitment to truth is an ethical imperative. Cynicism about the possibility of objectivity destroys the basis of ethics; it also destroys the basis of research" (p.81).

Validity and reliability

Some of the major criticisms of qualitative approaches relate to the problem of adequate validity and reliability. As stated by Burns (2000)

> ... the subject of validity is complex, controversial, and peculiarly important in research. Here perhaps more than anywhere else, the nature of reality is questioned (p.350).

According to Burns it is difficult to apply conventional measures of validity and reliability to qualitative conventions because of the subjective nature of qualitative data and its origins in single contexts. This in turn limits the extent to which such context-specific results can be generalised or the research replicated in other contests. Burns moderates these limitations by stating

> Basically, the richness; individuality and subjective nature of a participant's perspective and understanding are not amenable to the usual scientific criteria. This does not, however, make such understandings any less real or valid for the participant, and their explanatory function for the person's behaviour are highly predictive (p. 12).

The researchers ensured the validity and reliability of the Project on Learning in the following ways:

Validity

High validity was ensured through the use of a multi-method approach to collect data. The methods used included the following:

- pre and post-tests tests specifically designed to test the students' understanding of concepts and learning outcomes the teacher had planned for the unit;
- observations using specifically designed 15 second interval recording sheets and established coding systems to ensure consistency of recording between observers, and consistency of subsequent transcribing of the observational data;
- audio and video recordings of the subjects' verbalisations and behaviours;
- audio recordings of the teacher's verbalizations;
- extensive interviews of teachers and subjects;
- photocopied records of all work produced by the subjects;
- photographs or photocopies of all books, or extracts of texts, and other resources used by the subjects.

This range of data collection methods contributed to the overall high validity of each of the studies in the following ways.

Use of pre and post-tests

The pre and post-tests were considered to have high content validity for each particular class in each of the studies, due to the fact that they were specifically written after discussions with the teachers about the concepts they had planned for inclusion in the unit. According to Burns (2000):

> "An achievement test has content validity if it represents faithfully the objectives of a given instructional sequence and reflects the emphasis accorded these objectives as the instruction was carried out" (p.352).

While the pre and post-test items were written according to the teachers' intended unit content, there were occasions when some of the concepts that had been included in the pre-test were not taught. These test items were deleted from the post-test and the students' pre-test scores adjusted accordingly.

In-class observations

The observations conducted by the researchers provided additional data that may not have evident on the audio and video recordings. For example, information written on the white board that may have remained only briefly before being erased was recorded by the observers. The information recorded by each observer in relation to a particular subject could be used by all other observers in their subsequent analyses, and by the transcribers to supplement the audio and video-recorded data, for example if a subject had moved out of camera range. The use of fifteen second interval recording sheets, and the synchronisation of observers' stop watches with the time coders on the audio and video recording equipment enabled reliable cross checks of students' verbalisations and behaviours to be made.

Audio and video-recordings

The audio and video recorded data, when supplemented with the observations, provide a complete record of teacher verbalisations and of each subject's behaviours and their private and public verbalisations. From this data, a number of quantitative analyses could be made. For example, the number of opportunities afforded to students for cognitive engagement with concepts, the rate at which individual subjects raised their hand in response to the teacher's questions, or the number of content and non-content related verbalisations made by each subject.

Interview data

The interviews conducted with teachers and subjects contributed to the high validity of the studies. The subjects' understanding of the concepts presented in the pre and post-tests could be validated during the content-related interviews. This was particularly important when the items were multi-choice and where there were inconsistencies in a subject's response. Interviews enabled the researchers to determine whether the subject understood the concept, had simply guessed the answer, or whether they had a misconception about a concept.

Use of interviews to reflect multiple view points and multiple realities of specific social relationships

In educational research there is justification for the use of at least three viewpoints in analysis. Through conducting several in-depth interviews with both teachers and students as participant observers, the researchers in the Project on Learning ensured that their data and subsequent analysis of responses reflected multiple view points and the multiple realities of specific social relationships (Burns, 2000). Interviews conducted with teachers and students about their perceptions relating to classroom processes were valuable in explaining the relationship between teaching and learning, and the influence of the range of socio-cultural processes that impact the classroom experience of teachers and students.

Photocopied records of all work produced by the subjects

Photocopied records of all work produced by the subjects enabled the observational and recorded data to be supplemented and enriched, and facilitated a range of quantitative analyses of the data. Examples of quantitative analyses of written work include the following: the quantity and quality of work produced in a specified time, the extent to which a subject had followed the task instructions, and a comparison of the content of the subject's work with the resources they had used to determine the extent to which the content was the subject's own or whether it had been copied. In addition, the subject's written work could be used to further explore their understanding of the concepts during interviews.

Photographic and photocopied records of teacher resources

Photographic and photocopied recopied records of the teachers' resources such as diagrams, charts, pictures, extracts from texts, and all books and resources used by the subjects enabled the researchers to determine the extent of a subject's opportunity to cognitively engage or interact with a concept, even when that interaction occurred privately, for example when a subject was individually reading information from a wall chart.

The use of the multi-method approach described above enabled the researchers to gather data from a range of sources, supplemented by data which could be used with high validity to record the total and unique classroom experiences of individual subjects.

Reliability

Reliability is defined by Burns (2000) as "...the relative absence of errors of measurement in a measuring instrument" (p.337). According to Burns, with all data we must ask the following questions:

- Was the assessment instrument/technique reliable and valid?
- Were the conditions under which the data were obtained such that, as far as possible, only the subject's ability is reflected in the data and that other extraneous factors had as minimal an effect as possible? (p. 336).

It is considered that the use of multi-methods of data collection employed in the Project on Learning as discussed previously, contributed to the reliability of the data as well as the validity. In response to Burns' first question, the validity of the data collection procedures has already been established. In relation to the pre and post-tests, the content was based on information gained directly from the teacher in respect of the learning outcomes and content intended for inclusion in the unit. In response to Burns' second question, the pre and post-tests were administered under test conditions. As previously discussed, the subject's understanding was validated in the content-related interviews which minimised the effect that answers in a test situation may have been copied from another student's paper, or alternatively, may have been guessed by the subject.

The use of audio and video recordings and observations ensured that all verbalisations and behaviours were recorded, even when subjects may have moved out of camera range. Any errors or omissions were minimised due to the fact that the researchers were able to cross check their data from a number of sources.

Procedures for identifying unreliability in the data by Spector (1984) and employed by Alton-Lee (1984) in her doctoral research were also used in the analysis of data in the Project on Learning. Spector described the analysis of a subject's statements for inconsistencies as a useful checking procedure. In the Project on Learning, as in Alton-Lee's study, the subjects' interview responses were checked against test responses, public in-class responses, and the content of their permanent products, for example, writings and drawings. In addition, they were checked against the video recordings and observers' records, and examined in depth during the video-stimulated recall interviews. Analyses of data to establish consistencies or inconsistencies in the relationship between subjects' behaviour variables and task contexts

were facilitated in particular by the use of video recordings and modified experience sampling techniques. The subjects' interview responses were systematically compared with the quantitative findings.

Inter-rater reliability

Detailed transcribing of recorded data was supplemented with observational data. The transcripts were coded independently by at least two researchers. The results were then compared for inter-rater reliability. Comparison of results demonstrated that the coders concurred at a rate of approximately 95%. Where there was disagreement, the principal investigator independently coded the segment of transcript and all three researchers discussed the results until consensus was reached.

Triangulation of data

The comprehensive range of data collection procedures employed in the Project on Learning enabled the triangulation of audio and video recorded data, and observational and interview data using the following procedures:

- The audio and video recorded data was transcribed and triangulated against the observational data for consistency and to identify any omissions.
- The subjects' written test responses were triangulated against their verbal responses in the content-related interviews. Interview responses could be compared with observational and recorded data for consistency. Through comparing the subject's responses during the interviews, with the written test data, it was possible to identify the extent of their understanding or any misconceptions they may have held about specific a concept.
- The quantitative analyses of the recorded and observational data were triangulated against the subjects' test responses and their interview responses to provide information about unobservable cognitive processing associated with observable behaviour patterns (Alton-Lee, 1984). By comparing the data sets, the specific instances and events that contributed to the subjects' understanding, or alternatively, their misunderstanding of particular concepts could be identified.
- Student, teacher, and observer perceptions about particular classroom activities and processes were triangulated to establish the degree of congruence in those perceptions (Alton- Lee, 1984). For example, students and teachers were questioned about their perceptions of the prerequisite skills for effective group work. In many instances, the subjects considered their group to be operating ineffectively due to factors such as the composition of the group or domination by one or two members. The teacher's perception of the same group was often quite different. On the surface it may have

appeared to the teacher that the group was working co-operatively. Student and teacher perceptions could then be compared to the observed and recorded data.

- The subjects' written responses on the mood slips used in the modified experience sampling procedure were triangulated against the subjects' responses in the video-stimulated recall interviews for congruence of mood and emotional states at a specified time.

Effects of observer presence

One of the limitations of observation is the potential influence that observer presence may have on the behaviour of those being observed. According to C.M.Smith (1998) the effect of an observer tends to be greater when the subjects are aware that they are part of a study, or in the case of older children and adults, when they are sensitive to behaving in ways that are considered to be appropriate. In such cases there is the risk that subjects will behave in ways that are atypical for them.

The effects of observer presence were minimised in the Project in Learning in the following ways:

- Familiarisation period prior to the commencement of any observation or recording of data. During this time students were familiarised with the equipment and became used to the presence of other people in the classroom. In addition, the researchers used this time to establish trust and rapport with the students, engaging in social conversation outside of the observed sessions.
- Conducting observations discretely and room vantage points that ensured the normal classroom routines and movements of teachers and students were not disrupted.
- Avoiding verbal interaction or eye contact with students during observations, unless specifically requested by the student.

The issue of the effect of observer presence was raised with the teachers during interviews conducted at the end of each study. Teachers consistently reported to have been unaffected by the presence of either the observers or the recording equipment. The following excerpt from an interview conducted with the teacher from Studies 12 and 14 is typical of the teachers' responses in relation to the effects of observer presence.

Interviewer: How did you find our presence in the classroom?

Teacher: Fine. You forget about it once you get going. You're so wrapped up in what you want done for that day that I didn't really, don't register that you're there. Definitely not with the microphones or cameras.

I: So you didn't find us too invasive in there?

T: No. Well, for me personally, if you're concentrating on the job and I'm thinking about what it is I want to teach and how I want to get it across and what I want them to get at the end of the lesson, the cameras just didn't even figure. And neither did the microphone. And you guys sitting around the room. There could have been twenty there. Probably twenty and I would have thought, oh my goodness, that's a lot of extra people! But then again, once you start, or once I started it was, the classroom could have burned down... You are unobtrusive. You're sitting in a corner just saying nothing so for me it wasn't a problem.

Generalizability

The question of generalizability is one that is often asked in relation to findings of qualitative research. The author does not consider the issue of generalizability in a conventional way in relation to the findings presented in this thesis. The focus of the data collection and analysis has been on the total classroom experience of selected subjects in a particular classroom context at a particular point in time.

Time required for data collection, analysis and interpretation

Burns (2000) states that one of the major limitations of qualitative research is the time required for data collection, analysis and interpretation. The author concurs with Burns. Conducting eight classroom based studies over a period of two years, and the associated transcribing, coding, collation, and qualitative and quantitative analysis of data is an extremely time consuming and costly process. Ultimately however, the strength and integrity of the Project on Learning methodology lies in the intensity and richness of data that results from the use of such comprehensive methods of inquiry.

Summary

In summary, there is an established need to use a range of research approaches that enable the researcher to observe and record the dynamic processes that occur in the context of the classroom, and which, because of their subtleties and complexities could go undetected through the use of more standardised measures. The Project on Learning employed a comprehensive range of highly developed data collection procedures that had been used extensively in previous studies and which had proven to be reliable. The comprehensive transcribing, coding and collation of data enabled the measure of a subject's engagement in a wide range of specified behaviours, many of which may not be evident to the teacher in the context of the busy classroom. The examples provided demonstrate the many differences between students and raise a number of issues in relation to the opportunities for cognitive engagement in individual, group and whole class tasks and activities.

The use of both qualitative and quantitative conventions was considered to be particularly suitable for recording in total, the unique classroom experience of individual students, and for the detailed analysis required to answer the research questions central to the Project on Learning and to this thesis.

Second phase of analysis

It should be noted that immediately following the first phase of data analysis, my principal supervisor Professor Graham Nuthall was taken ill and was unable to carry on in his supervisory role. This necessitated the appointment of a new supervisor and a period of time was required to familiarise her with the extensive Project on Learning methodology and the focus of my thesis.

The decision to increase the focus on teacher-student discourse was made in consultation with my new supervisor. Approximately one year after the completion of the initial analysis and coding of data, an additional three months was spent on an extensive second phase of data analysis. The specific focus of the analysis was on the classroom discourse that occurred within the selected lessons. This proved to be of real value in adding to and complimenting the initial analysis, in particular illuminating the subtle but significant impact of teacher-student discourse on the teaching-learning relationship.

In the next chapter, the context for the studies is provided. This includes an overview of the units from which the two lessons selected for analysis were drawn. In addition, the structure of the lessons and descriptions of the tasks undertaken by the students in each lesson are provided.

CHAPTER 4

CONTEXT FOR THE STUDY

In this chapter, the context for the study is described. The chapter begins with a summary of the eight studies in the Project on Learning. An overview of the range of classroom tasks and activities observed over the course of the eight studies is provided. This is followed by a discussion of the rationale for the selection of the two lessons that are analysed in Chapters 6 and 7. Finally, in order to contextualise the lessons within the Project on Learning, the following information is provided for each lesson:

- An overview of the unit in which each lesson was conducted, including details of the teacher's planning and the major aims and objectives of each unit.
- An overview of the general structure and main components of each lesson.
- A description of each of the activities undertaken by the students in each lesson.

Studies in the Project on Learning

The Project on Learning was comprised of eight studies conducted over two years. Table 8 provides a summary of the curriculum areas, titles of the studies, number of hours in each study, and the number of days within which each study was conducted.

Table 8

Studies in the Project on Learning

		1999	**Hours**	**Days**
Study 11	Science – Colours		8.4	9
Study 12	Science, Art – Light & colour		14.2	10
Study 13	Social studies – Ancient Egypt		14.8	15
Study 14	Social studies – Migration & other cultures		16.9	14
		2000		
Study 15	House planning & design-maths, science, & social studies		20.2	13
Study 16	Science – Kitchen Chemistry		8.3	11
Study 17	Science & Social Studies – Space		12.2	9
Study 18	Social studies & Art: Learning about the Aztecs		20.2	19
		Totals	155	130
		Average	12.9	10.8

Overview of the classroom tasks and activities observed in the eight studies

In general, the tasks and activities planned and implemented in the eight studies in the Project on Learning may be typically classified into three main types:

- predominantly whole class with some small group or individual activity components;
- predominantly small group with some whole class or individual components;
- predominantly individual with some whole class or small group components.

Examples of activities used by the teachers in each of the three categories

Predominantly whole class with some small group or individual activity components including:

- brainstorming – generally at the beginning of a unit or lesson to determine prior knowledge or to clarify understanding ; brainstorms may be conducted with whole class, with small groups reporting back to the whole class, or individual with reporting back to whole class;
- teacher demonstrations or modelling of activities while students observe or follow;
- teacher reading to students with whole class discussion to follow;
- worksheets prepared by the teacher, or copied from commercially produced resources;
- whole class discussions and debates, generally led by the teacher;
- copying information from the board, with the whole class copying the same material simultaneously;
- whole class instructions for activities that require students to work individually on the same activity simultaneously-bookwork is included in this category;
- activities designed specifically by the teacher to clarify a particular concept or misconception;
- whole class viewing of videos with possible related follow-up activities.

Predominantly small group with some whole class or individual components including:

- conducting group experiments, particularly in science units;
- group brainstorms;
- project work in small groups or with partners;
- group or partner presentations;
- construction activities;
- computer activities;
- drama activities, for example writing and presenting plays;
- small group research activities.

Predominantly individual with some whole class or small group components including:

- individual project work;
- worksheets;
- research with presentations to groups or whole class;
- construction activities;
- individual work from text books;
- copying information from a variety of sources;
- conferencing with the teacher;
- learning centre activities with students undertaking activities individually;
- individual contracts with teaches allocating students a number and range of activities for completion within a specified time period;
- individual contributions to group or whole class debates and discussions.

Nuthall (2000) identified the need for an analysis of classroom activities that incorporates more of the complexity and diversity of classroom life. The analysis needs to be both more generic, so it can account for the variety of different types of classroom activity, and more specific, so that it is possible to relate it directly to the details of student experience.

When selecting the lessons for analysis, it was considered important to take into account the considerable variations in teacher planning and implementation of lessons and activities in Year 5 and Year 6 classrooms in typical science, social studies, and integrated units. Such variations may include the topic for study, the length of the unit, the duration of each lesson, the composition of the class, the type of activities selected for inclusion in the unit, specific curriculum or school requirements, and the teacher's own philosophy. There is also considerable variation in the way in which individual lessons are structured. Lessons may require students to work in a variety of ways and in different groupings within the classroom. Part of a lesson may require students to participate within the context of the whole class, for example, contributing to a brainstorming session, while another component of the same lesson may require students to work individually.

In order to take into account the range of activities used by teachers in the eight units, and the variations in the way in which lessons were planned and implemented, two separate lessons were selected for analysis. These lessons and associated activities are considered to be representative of the range that might typically be found in Year 5 and Year 6 classrooms in New Zealand, particularly in science and social studies curriculum areas. The activities have been selected to provide examples from each of the three main types described in the previous section.

In the following section, a brief description of the two lessons is provided. This is followed by an overview of the unit in which each lesson was conducted, the general structure and main components of each lesson, and a description of each of the activities undertaken by the subjects.

Definition of an activity

In the literature, the terms 'classroom tasks' and 'activities' are used interchangeably. For the purpose of the analysis of the activities contained within the two selected lessons, Nuthall's (2000) definition of an activity will be used.

> A classroom activity is defined as a sub-unit within a larger curriculum unit or topic that is focused on a significant concept, understanding, principle or skill that the teacher intends the students to learn or acquire. Often such a sub-unit will revolve around a particular pattern of classroom organisation such as a whole-class discussion, a small group interaction, or individual seatwork. However, most of the sub-units defined as classroom activities involve some mixture of these patterns. So, for example, a social studies activity might begin with a whole-class discussion, change to a small group research activity, and end with the students working individually on a written report. What holds the activity together is the intended curriculum purpose or learning outcome (p.14).

Nuthall describes an activity as having both structure and process.

> The structure describes what is common to the sequence of behaviours that occur on different occasions and in different contexts. However, what happens on any one occasion is not an exact replica of what happened on previous occasions. There are variations, and these variations are not just incidental or accidental. The process of carrying out an activity on a particular occasion is the product of the interactions between the individuals concerned: their personal characteristics, goals, and past histories. The enactment of an activity involves both the structure (the expected and predictable sequence of tasks and behaviours) and the process (the dynamics of interactions between the individuals and their personal characteristics) (p.13).

Overview of the units, lesson structure, and description of activities selected for analysis

The following two lessons and three activities have been selected for analysis:

Lesson One

A 53 minute lesson conducted on Day 7 of a social studies unit entitled "Learning About the Aztecs". The lesson contained an individual research question writing activity, with whole class discussion and instruction components.

Lesson Two

A 49 minute lesson conducted on Day 5 of a science unit entitled "Kitchen Chemistry". The lesson contained two activities involving science experiments conducted in groups, and some whole class discussion and instruction components.

Lesson One

A 53 minute lesson conducted on Day 7 of a Social Studies unit "Learning about the Aztecs"

This particular lesson has been selected for analysis as an example of one lesson that included an initial whole class instructional phase, followed by an individual activity component. The teacher had two main objectives for the lesson. Through teacher-led whole class instruction and discussion, students would demonstrate their understanding of open and closed questions, and how to write them. Secondly, students would individually write an unspecified number of open and closed questions on one selected aspect of the topic. These questions would guide their independent research during the remaining two weeks of the unit.

Overview of the Social Studies unit in which the lesson was located

The lesson was conducted on Day 7 of a social studies unit entitled "Learning about the Aztecs". The unit was taught in a high ability streamed composite Year 5 & 6 class of 28 students in an urban contributing school. Designated by the teacher as the major social studies topic for the year, the five-week unit was conducted over 29 sessions, comprising a total of 20.2 hours. Due to the integrated nature of the unit, the sessions were conducted in normal reading and language periods, in addition to the regular topic study periods scheduled for the afternoons.

Teacher planning of the unit

In the preliminary planning discussions with the teacher prior to compiling the pre-test, the teacher specified the following three main areas of focus for the unit:

- The ways in which history is recorded;
- The leadership system (male dominated monarchy);
- Bartering and the monetary system.

In addition, the teacher planned to incorporate some or all of the following:

- Comparison of Aztec society to other ancient civilizations;
- Remains of Aztec civilisation (monuments and buildings);
- Investigating why the Aztecs changed from a bartering to a monetary system;
- Comparison of other countries with monarchies to New Zealand.

The teacher planned to use a variety of resources including the Internet, and a comprehensive selection of library books from the National Library Service and local Teachers' College library. The main resource used by the teacher when planning the topic was a commercial publication entitled "Other Societies – Aztecs." A range of worksheets covering mapping, mythology, markets and trading, social organisation, and gender roles in Aztec society were duplicated from this resource for use during the topic.

Activities planned for the unit are classified into three groups:

- Whole class, teacher directed activities;
- Independent research and individual or small group presentations;
- Mask making.

Sequence of events in the 53 minute lesson conducted on Day 7 of the study

Table 9 provides a summary of the sequence of events as they occurred in the lesson conducted on day 7 of the study.

Table 9:

Sequence of events in a 53 minutes social studies lesson.

Intervals	Total number of 15 second intervals	Total time in minutes	Event
1-6	6	1.5	Sheets distributed from previous sessions
7-58	52	13.0	General instructions for writing questions
59-70	12	3.0	Students glue sheets into topic books
71-104	34	8.5	General instructions for writing questions (continued)
105-195	91	22.75	Individual question writing activity
196-212	17	4.25	Whole class discussion of questions
Total	212	53.0	

Table 9 demonstrates the time allocated to the events of the lesson and the sequence in which they occurred. The main components of the lesson will be described under the four distinct but frequently overlapping task components identified by Nuthall. These components are: instructions, carrying out the activity, preparing a report, and discussing the results.

Overview of the 53 minute social studies lesson

Instructions

See intervals 1-104 (Table 9)

The teacher conducted a whole class instructional phase on question writing for the first 26 minutes of the lesson. This included three minutes from intervals 59-70 to enable students to glue their "Skills Hand" resource sheet into the front of their draft topic books.

Carrying out the activity

See times 105-195 (Table 9)

Following the instructional phase, students were given 22.75 minutes to nominate an aspect for independent research (if they had not already done so in the previous session), and to write a set of open and closed questions on which to base their research. In this lesson, the report writing component of the activity constituted part of this phase of the lesson.

Discussing the results

See times 196-212 (Table 9)

The lesson concluded with a 4.25 minute whole class, teacher-led review of the question-writing phase of the lesson. Students were selected to read out some of their questions to the class.

Description of the individual question writing activity introduced on Day 7

Fundamental to the research component of the Aztec unit was the requirement for students to write their own research questions to guide their independent research. The individual research question writing activity was introduced on Day 7 of the study. Following the instructional phase of the lesson, students were required to write an unspecified number of open and closed questions related to their nominated aspect of Aztec life. The questions were to be written in the students' draft topic booklets according the following format specified by the teacher:

Page One

1. Topic=
2. Keywords =

Page Two

Closed Questions: Who, When, Where.

Page Three

Open Questions: Why, How

The balance of the 22.75 minute question writing activity was intended for students to write their own research questions. The teacher had specified that the activity was to be undertaken individually. While students could move to other areas of the classroom to work, they were instructed not to collaborate with other students about their questions.

Resources for use during the activity

Students who had been present at the previous lesson were given back the photocopied map sheet on which they had written their aspect for investigation, plus their initial key questions. During the instructional phase of the lesson, the teacher gave each student a photocopied resource entitled "Skills Hand:Designing Questions" from the "Other Societies – Aztecs" publication. The resource was intended to assist students to design questions. Each student also received a draft topic booklet, compiled by the teacher using unlined sheets of newsprint. Students were instructed to put all of their research information into this booklet. This included gluing in any loose sheets of paper that may have been used.

Preparatory activity

In preparation for the individual question writing activity, the teacher had given the students an activity to complete in the previous lesson on Day 6 of the unit. This preparatory activity required students to nominate one of the following six aspects of Aztec life they would be interested in researching independently during the remaining three weeks of the unit:

- Slaves and nobles
- Markets
- Warfare
- Farming
- Temples
- Communication

After recording their selected aspect, students were instructed to write three key questions as a focus for their research. The teacher collected the students' work at the end of the lesson on Day 6 to enable her to check the suitability of the questions in preparation for the lesson on Day 7. Students were advised that they would be able to focus on their own aspect and carry out their research either individually or with other students who shared a common interest. The teacher's concluding comment on Day 6 was "This is your opportunity to have a bit of input into what you want to study." It should be noted that some students, including two of the subjects, had not undertaken the preparatory activity. Ned had been absent on Day 6 so was unaware of the content of the previous lesson. Rewa had been present on Day 6 but had neither selected an aspect to research nor written any key words.

Lesson Two

A 49 minute lesson conducted on Day 5 of a science unit

This particular lesson has been selected for analysis as an example of a lesson where the teacher had planned two activities for students to undertake in groups. The lesson structure included a whole class instructional phase, followed by small group work where students were required to work on one of two science activities. One activity required students to make chemical popguns. The other activity required students to make a self-propelling boat. On the completion of the first assigned activity, the groups were required to undertake the second activity.

It can be considered common practice for teachers to plan more than one activity for students to complete during a lesson. The effects on students and teachers when more than one activity is being undertaken at any given time may be different than when the whole class is undertaking the same activity. This lesson has been selected for analysis to demonstrate these possible effects.

Overview of the science unit in which the lesson was located

The lesson involving the chemical pop-gun and the boat activities was conducted on Day 5 of a science unit entitled "Kitchen Chemistry." The unit was conducted in a Year 5-6 classroom over 11 individual sessions comprising a total of 9 hours 40 minutes.

Planning of the science unit

An initial planning meeting was held with the teacher to discuss her planning and learning outcomes for the full unit on Kitchen Chemistry. In order to meet the curriculum requirements, the teacher based her planning on the following resource: Making Better Sense of the Physical World (Levels 1-4) Fizzing and Foaming unit (pp 74-83), published by the Ministry of Education, Learning Media, (1998).

Selected Aims and Objectives for the Lesson Conducted on Day 5 of the Unit

The teacher selected the following achievement aims and objectives from the above document for the 49 minute lesson:

Achievement Aim 3: Investigate reactions, and applications of these, in chemical processes.

Achievement Objectives:

M3.3: Investigate and report on temporary and more permanent changes that familiar materials may undergo.

M4.3: Investigate and describe ways of producing permanent or temporary changes in some familiar materials.

Possible specific learning outcomes: levels 3 & 4: Be able to identify the factors that affect the production of carbon dioxide in cooking processes.

Assessment: Levels 3 & 4: Draw a diagram to represent and explain observations.

Relevance of the activities to the Project on Learning measure of concept learning

Relevance of the chemical pop-gun activity to the measure of concept learning

The chemical popgun activity is directly related to post-test item 16.

Item 16: What makes the cork pop out of the bottle?

Both activities contain partial information required to answer post-test item 19.

Item 19: This is what happens when you put baking soda into an acid. Fill in the missing name.

Acid + Carbonate = ---------- + salt + water.

The chemical popgun activity also contains partial information required to answer post test items 3,7,10,11,12, 14,15,17,18,26,28,30, and 31.

Relevance of the boat activity to the measure of concept learning

The boat activity contains partial information required to answer the following post-test items:

Item 10: What do we call something that will make bubbles if it is added to an acid?

- A gas
- A carbonate
- A powder
- Carbon dioxide
- I don't know.

Item 11: When you put some things in an acid, they fizz or make bubbles. Which of these things will fizz or make bubbles if you put them in an acid?

- Chalk
- Rain water
- Soap
- Baking Soda
- Paper
- Bread

The activity also contains partial information required to answer post-test items 3,7,12,14,15,16,17,18,19,23,26,28,30 and 31.

Description of the Chemical Popgun Activity

The chemical popgun activity required students to construct a 'pop-gun.' Using an empty coke bottle, students were required to add a mixture of vinegar and baking soda before inserting a cork into the neck of the bottle. If the correct ratio of ingredients was added, the pressure resulting from the chemical reaction between the acid and carbonate would cause the cork to eject from the bottle.

Description of the Boat Task

Called "Hey look, the bubbles do push the boat", this task required students to construct a self-propelling boat. Students were required to cut a small hole in a small plastic coke bottle. They then had to insert a straw into the hole, sealing around it with Blue Tack (a water proof adhesive material with a plasticine consistency). The required amount of vinegar was then to be poured into the bottle. The students then had to wrap the required amount of baking soda in a tissue and insert it into the neck of the bottle, replacing the cork. If the experiment had been completed successfully, the reaction of the soda and vinegar and the resulting pressure would cause the boat to be propelled through the water. In addition to the verbal instructions given by the teacher during the instructional phase of the lesson, the students were required to read the following written instructions before they could proceed with the construction component of the task.

Written Instructions for the Boat Task

"Hey look, the bubbles do push the boat!"

What you need:

- Vinegar
- Sodium bicarbonate
- A plastic bottle or a jar with a screw top lid (small ones of about 250 millilitres work best)
- A straw
- Blue-tack or a hot-glue gun
- Tissues
- A large container of water

What you do:

- Cut a small hole in the bottle and insert the straw
- Push it in so the end is three-quarters of the way up the side of the bottle
- Angle the straw so that any gas that escapes is pushed backwards
- Seal the hole with Blue-Tack or hot glue
- Pour vinegar into the bottle until it is one-third full
- Place 2 or 3 teaspoons of sodium bicarbonate in a single layer of tissue, roll it up, and twist the ends so you have made a small parcel
- Slide the tissue package into the bottle and quickly screw on the top
- Keep a finger over the end of the straw
- Give the bottle a quick shake and place this "boat" in the large container of water so that the straw is under the water.

The sequence of events in the 49 minute science lesson

Table 10

Sequence of events as they occurred in the Lesson Two

Times in 15 second intervals	Total Number of intervals	Total time in minutes	Event
1-4	4	1	General instructions to whole class
5-13	9	2.25	Revision with whole class
14-73	60	15	Instructions for tasks with whole class
74-93	20	5	Group experiments (pop guns & boats)
94-106	13	3.25	General discussion instructions to whole class
107-136	30	7.5	Group experiments
137-144	8	2.0	Settling students inside
145-158	14	3.5	Discussing pop-gun experiment
159-175	17	3.25	Whole class watches boat experiment
176-182	7	1.75	Instructions for report writing
183-196	14	3.5	Report writing
Total	196	49	

Table 10 demonstrates the times allocated to the events of the lesson and the sequence in which they occurred.

Overview of the 49 minute science lesson

Instructions

See times 1-62 (Table 10)

The teacher incorporated a whole class revision of the previous lesson, and a general discussion of the concepts relating to the chemical popgun and boat tasks into the instructional component of this lesson. The teacher commenced the lesson with a brief set of general instructions, followed by a three minutes revision session where students were selected to read out their statements from the previous session on chemistry.

Following the revision of the previous session, the teacher introduced the chemical popgun activity. While giving the instructions the teacher was questioning the students about possible reactions, and asking them to make predictions of the quantities of materials required. During this phase the teacher was simultaneously writing the ingredients for making chemical popguns on the whiteboard.

The teacher spent from time 40 to time 46 (1.5 minutes) very briefly outlining the boat activity and distributing a sheet of written instructions to each group assigned to the boat activity. The students were then instructed to move into their teacher nominated groups. The instructional phase concluded with the teacher highlighting the need for safety when conducting the experiments.

The teacher stopped the class frequently over the next 4 minutes in order to gain their attention, give further instructions, and wait for the students to organise their resources for their groups.

Carrying out the activity

See times 63-138 (Table 10)

The students moved into the six groups nominated by the teacher and spent approximately 19 minutes carrying out their respective group experiments. The teacher used 5.75 minutes of the 19 minutes to give further instructions and to discuss the progress of the group experiments. The students were expected to carry out the activities according to the instructions.

Discussing the results of the experiments

See times 145-175 (Table 10)

The teacher called the students together to discuss the results of the experiments. This discussion took place prior to the report-writing component of the task. The teacher asked the students who were unsuccessful the first time they attempted the experiment to state what they had done differently to make the experiment work on their second attempt. The need to add more of one ingredient was discussed, along with the concept of saturation. The teacher drew a diagram on the board to demonstrate the concept of 'optimum point.' The total time spent discussing the chemical popgun experiment was 3.5 minutes. The total time spent discussing the boat experiment was 1.75 minutes. This was followed by a one minute long demonstration to the whole class by the group who had successfully completed the boat task.

Writing the report

See times 179-147 (Table 10)

At the conclusion of the discussion of results, students were asked to write at least two sentences in their topic books about something else they had learned during the session. This meant it had to be new information and not a repeat of what had been written from previous sessions.

In the next chapter I present the qualitative and quantitative analyses of the introductory and instructional phases of Lesson One and Lesson Two.

CHAPTER 5

ANALYSIS OF THE INTRODUCTORY PHASES OF SELECTED LESSONS

The purpose of this chapter is to present the analyses of data related to the introductory phases of the two selected lessons, in particular the instructional phases. The chapter commences with a general discussion of the multiple purposes of introductory phases of lessons and the significance of the instructional phases of lessons in relation to student understanding of classroom activities. From this discussion, four aspects of the instructional phases considered to be critical to students' carrying out the three activities selected for analysis will be identified. These aspects will provide the framework for the analyses of the teacher's practice and the subjects' individual experiences of the introductory and instructional phases of each lesson. Data from Lesson One (Aztecs question writing activity) will be presented first, followed by data from Lesson Two (chemical pop-gun and boat construction activities).

Purposes of the introductory phases of lessons

Teachers use the introductory phase of lessons for multiple purposes. In a typical social studies or science lesson, the introductory phase may be used to revise and discuss previous lessons or related concepts, to provide an overview of the lesson to be undertaken, and to engender student interest. The teacher may draw on students' prior knowledge and experience, providing opportunities for them to see the relevance and purpose of the topic and related activities. By tapping into students' goals and interests, the teacher may motivate the students to engage with the topic and undertake the assigned activities.

In general, the primary purpose of the introductory phase of a lesson is to provide students with instructions for new activities. Fundamental to the successful undertaking and completion of classroom activities is the student's ability to correctly interpret and manage the instructional phase of a lesson. Nuthall (2000) describes this as the instruction-evaluation system.

> ...the system that is set up by the teacher's instructions and expectations about how students should follow instructions. This system is the public system of classroom activities that the teacher designs, organises and manages both directly and in face-to-face interaction with the students, and indirectly through group tasks (p.16).

The instructional phase is most commonly used to explain the activity requirements and to instruct students on the preferred ways of carrying out the activity. When used for this purpose, the instructional phase will typically include the allocation of activities to the whole class, groups, or individuals, with instructions for following procedures and managing resources. Instructions may be provided in a variety of ways including verbally, in written formats, modelled by the teacher, or by using a combination of methods.

The structure and complexity of instructional phases of lessons may vary due to a range of factors including the following: the teacher's planning and personal philosophy; the topic being taught; the duration of the lesson; the number and type of activities to be included; the purpose of the instructional phase; the use of resources; the number of students receiving the instructions; organisational considerations, for example grouping of students, and opportunities for student participation.

It may be assumed that teachers plan activities and give instructions in ways that they expect their students to interpret and successfully complete them. Some activities may be sufficiently routine or straightforward that there is little opportunity for students to misinterpret the instructions or deviate from the specified procedure for completing the activity. It cannot be assumed however, that even the most explicit of instructions will be interpreted by all students in the way the teacher intends, particularly with instructions that are not carried out in a routine manner, or where students may be interpreting them for the first time.

The process of following instructions may become increasingly complex when students are required to negotiate further interpretation of instructions with the teacher or peers. Previous research by Nuthall (1999) found that the instructions given for classroom activities were never fully explicit, and that their meaning depended on the mutual understandings that the teacher and students had developed about what is expected in similar activities.

While the majority of the instruction-evaluation system takes place prior to the commencement of an activity, students are often required to continue to interpret instructions as they progress through the activity. Although teachers may give explicit instructions, these must be interpreted by the students in relation to their previous experience in that particular classroom. Students must interpret what the teacher really intends them to do. Adding to the complexity is the fact that as an activity progresses, new and unexpected circumstances occur. According to Nuthall (1999), students must then reinterpret instructions according to these circumstances, in addition to the exigencies of the social context, the physical resources, and the personal knowledge the students bring to the task.

The way in which this continued process of negotiation and interpretation of the instruction-evaluation system occurs may also be influenced by a range of factors that may be operating within the students' groups or the wider context of the classroom. The more assertive or persuasive students may challenge the understandings of their peers, even when the peers may have a better understanding of the concept. The extent to which students correctly interpret, or alternatively misinterpret instructions may also be deliberate. Students may make conscious decisions about how to interpret instructions based on their existing understandings and prior

experience of the rewards and consequences of compliance or non-compliance with instructions.

Within the two lessons selected for analysis, there are contrasting examples of individual and group tasks. Despite the variation in the tasks that the teacher was introducing and providing instructions for, the introductory phases of the two lessons followed a similar pattern with each lesson starting with a whole-class, teacher-led instructional phase. The following analyses of the instructional phases of the two lessons are structured using the following four sub-headings, selected as being critical factors for consideration in relation to the engagement of students and to their subsequent participation in assigned activities.

1. Teacher planning and organisation of the instructional phase including:
    - Purpose
    - Class organisation
    - Length of the instructional phase
    - Type of activity

2. Method of giving instructions including:
    - Verbal
    - Written
    - Modelling
    - Use of resources

3. Classroom discourse including:
    - Teacher-student interactions
    - Student-student interactions
    - Use of questions
    - Monitoring of student understanding

4. Characteristics of individual learners including:
    - Own skill and knowledge
    - Interest
    - Participation and engagement
    - Confidence and self efficacy
    - Social status within the class

Analysis of the introductory phase of Lesson One, conducted on Day 7 of a social studies unit on the Aztecs

1. Teacher planning and organisation of the introductory phase

Purpose and structure of the introductory phase

The introductory phase of the lesson was conducted in a whole class context in the first 26 minutes of the 53 minutes lesson. Students were seated at their own desks for the duration of the lesson. Table 11 demonstrates the sequence of events during the introductory phase.

Table 11

Sequence of events in the 26 minute introductory phase of Lesson One

Time	Event	Total intervals	Minutes
1-6	Distribution of question writing resource	6	1.5
7-12	Revision of previous lesson	6	1.5
13-30	Discussion of question writing resource	18	4.5
31-60	Distribution of topic books, discussion of procedures for setting out questions, discussion of open/closed questions	30	7.5
61-73	Glueing resource sheets into topic books	13	3.25
74-104	Discussion of deep and surface thinking, keywords, further discussion of procedures for setting out questions	31	7.75
	Total	104	26.00

The main purpose of the introductory phase was to instruct students how to write open and closed questions that would form the basis of their independent research into one selected aspect of Aztec life. This was clearly stated by the teacher in the first 30 seconds of the session. "You will be designing questions to find the answers to, looking particularly at the type of questions you will design and how you will go about answering those questions and in which detail you will do that".

It should be noted, that as described on p.162 in the previous session (Day 6) the students were required to copy the six aspects of Aztec life nominated by the teacher for the individual research component of the topic. They were then required to select one aspect of interest in preparation for writing their research questions, and to nominate three key words relevant to their selected topic. One of the subjects, Ned, had been absent on Day 6 so was unaware of the research activity and had not completed any of the preparatory tasks.

The teacher used the first three minutes (times 1-12) to distribute a commercially produced sheet entitled 'Skills Hand: Designing Questions,' and to ask students to recall the six aspects of Aztec life nominated by her on Day 6. At the end of the three minute revision period, the teacher stated that students could change their selected aspect but would have to select a new one within the next ten minutes. From this comment it may be assumed the teacher expected the instructional phase to last approximately ten minutes. As demonstrated in Table 11 the introductory phase of the lesson lasted for 26 minutes.

2. Methods of giving instructions for the question writing activity

The teacher used two main methods of providing instructions for the question writing activity. Instructions for the question writing activity were based on the 'Skills Hand: Designing Questions' sheet. In addition, the teacher wrote a model on the whiteboard to demonstrate how the students were to organise their questions in their individual draft topic books. The 'Skills Hand: Designing Questions' sheet is reproduced below.

Skills Hand: Designing Questions.

Name: Topic:

Use the 'steps' to designing questions below to assess yourself. Tick the boxes as you complete them. Of course you can use this 'skills hand' each time you need to form questions to begin research, for interviewing people, or for clarifying issues. Ask another student to check / assess you.

Identify issue, topic or problem to focus questions.

Identify key words to your study / issue / problem.

Use the key words to form questions which begin with Who, When, Where, closed questions to establish a factual base.

Use the key words to form questions which begin with what, why and how, open-ended questions, which will gather examples and detail.

Check that you have a range of questions which cover different aspects of your study.

Which steps can you do well?.....

Which steps do you still need to improve on or need help with?.....

The teacher spent the following 4.5 minutes (times 13-30) going through the steps on the sheet, occasionally pausing to ask students the difference between open and closed questions.

The teacher then distributed individual newsprint topic books for the students to use to record their research questions. Discussion over the next 7.5 minutes (times 31-60) centred on the use of the booklets and how to set out their questions in them. There was some discussion of open and closed questions interspersed throughout the discussion.

Students spent the following 3.25 minutes (times 61-73) gluing the 'Skills Hand' resource sheet into their topic books. The final 7.75 minutes (times 74-104) of the instructional phase comprised further discussion of deep and surface thinking, the use of key words, and further general instructions for setting out of work.

The instructional phase concluded with the teacher stating that students had approximately thirty minutes to write their questions and her expectations of how the time should be used.

> It might be that you decide to change your topic because you want to look at something else. I would think that it would take you at least fifteen minutes to choose your topic, to work out what your key words are, to design your closed questions and to design your open questions. If you get further than that you can start going and have a look at the books.

The final instruction given at time 104 specified the requirement for students to work on their own. "I don't want you interacting with anyone else. I want these questions to be only your questions, not anybody else's."

Analysis of the 'Skills Hand: Designing Questions' resource

This commercially produced resource was the primary resource used by the teacher to assist students to write their research questions. An analysis of the resource shows that much of the content was either too difficult for many of the students in the class to interpret, or was not relevant to the specific activity.

As the teacher started to go through the instructions on the sheet she stated: "Identify the issue, topic, or problem to focus your questions. Well that's easy enough for most people." Rather than easy, it is considered that some of the wording is quite complex for students of this age. The students' understanding of the activity, based on the teacher's previous comments was that they were to write questions on one aspect of Aztec life. The first instruction on the sheet introduced three different distracters; issues, topic, or problem. These three terms were repeated in the second instruction that required students to identify key words associated with their issues, topic, or problem. Students were then instructed to use the key words to write closed questions to establish a factual base. To interpret this complex terminology, students would need to understand the meaning of establishing a factual base.

The fourth instruction was also stated in one complex sentence that required students to use key words to form open-ended questions that would gather examples and detail. The final instruction may have caused some students concern as it stated the need to check that they had a range of questions that would cover different aspects of their study. This contradicted the teacher's requirement for students to select only one aspect to research.

The sheet also suggested that students evaluate how well they could do, and which steps they still need to improve on or need help with. As the teacher read this statement she commented that the students could ask a friend to check which steps they could do well. Some students may have seen her comments as a way of legitimately discussing their questions with their peers.

This was in contrast to her previous instructions that the questions were to written individually and that there was to be no collaboration.

It is considered that this type of commercially produced resource is unsuitable for use with students at Year 5 and 6 levels. Only some of the information was relevant to the assigned task. The terminology is different from that used by the teacher in her verbal instructions to the class, necessitating clarification by the teacher and the potential for incorrect interpretation of meaning by students. The complexity of the language used demonstrates an assumption on the part of the resource writers that students of this age will have the prerequisite vocabulary and reading skills to enable them to correctly interpret the content. The sheet also contains grammatical errors and inconsistency in the use of capital letters.

The unsuitability of the resource and its limited value for use with Year 5 and 6 students is confirmed by the fact that the only time the students appeared to use the resource was as paper to doodle on during the instructional phase. One of the subjects (Rod) appeared to be looking at the sheet while the teacher was giving verbal instructions. His later interview comments about reading things when he is bored may indicate that his reading of the sheet was simply something for him to do during the lengthy instructional phase. None of the subjects was observed to refer to the sheet while writing their questions.

The use of commercially produced resources has become an accepted part of teachers' practice. Curriculum co-ordinators are typically allocated budgets to purchase resources and school staff rooms are often full of samples of the latest publications. Busy teachers are often seduced by the glossy, attractively packaged resources that come complete with photocopy masters of activities and worksheets. While some of the material may be useful to teachers when planning a topic, a close analysis shows that only some aspects will be relevant to the

teacher's specific planning. As shown with the 'Skills Hand' sheet, much of the information did not apply and was confusing rather than useful. The teacher then had to spend time clarifying the information. This time would have been better used designing a question writing guide specific to the activity, and that would give clear examples of open-ended and closed questions that were related to the six aspects and that were compatible with the students' reading and comprehension levels. It is strongly argued that such resources are of limited value in meeting the diagnosed needs and interests of individual learners.

3. Classroom Discourse

In this section of the chapter, an analysis of classroom discourse during the introductory phase of Lesson One is provided. Data is grouped and discussed as follows:

- Opportunities for student interaction during the introductory phase;
- Teacher language: type and level of complexity;
- Frequency of teacher use of selected words;
- Teacher assumptions about students' existing knowledge and understanding;
- Effects of teacher assumptions on student participation;
- Teacher instructions related to the individual nature of the activity;
- Teacher questions related to content;
- Student-initiated questions and statements in relation to content;
- Teacher questions related to procedural matters;
- Student questions related to procedural matters;
- Teacher language when acknowledging students' responses;
- Teacher language related to management of students.

Opportunities for student participation in the introductory phase of the lesson

The data shows that for a total of 85 of the 104 fifteen seconds intervals (20.25 minutes of the 26 minutes), the teacher was the only person in the class to be talking. As a result, there were limited opportunities for students to interact with the teacher or their peers, or for the teacher to monitor their understanding. Time available for whole class discussion when students were able to answer teacher questions related to content and procedural matters, and to seek clarification of their understanding of the activity was limited. In total, 13 of the 28 students interacted with the teacher on a total of 25 occasions during the introductory phase. The interactions were brief and occurred during a total of 23 intervals (5.75 minutes). Thirteen of the 25 interactions involved the same two students. The student with the most interactions was Dexter who interacted with the teacher on 8 of the 25 occasions. He asked six questions related to procedural matters. In addition, he was one of the five students selected by the teacher to respond to the three content-related questions. Jed had the second highest rate,

interacting on five of the 25 occasions. He was selected by the teacher to respond to one of the content-related questions and he asked four questions related to procedural matters.

Teacher language: type and level of complexity

The language used by the teacher to introduce the content and give instructions for the question writing activity varied from being at a level that should have been readily understood by all but the two ESOL (English as second language) students, to language that is considered to be complex and beyond the comprehension of some Year 5 and 6 students. Terms such as 'establishing a factual base', 'inquiring-type questions', and 'more defined', are considered to be quite complex for some ten and eleven year old students.

The teacher used two main strategies to assist student understanding and limit possible confusion or misunderstanding of the concepts. These strategies included comparing the new activity to activities that students had previously undertaken, and the simplification of the language used in the 'Skills Hand' resource sheet. An example of the use of comparison of the question writing activity with previous activities occurred between times 15-16 when the teacher referred to the research process, asking students to recall previous studies.

> We've looked at different ways this year of researching. We looked at this one, going through, deciding, refining, finding, using, recording, presenting and evaluating. Takes quite a long time. Takes about six weeks to go through that. And that's what we did with our painters when we were talking, ah, when we were researching about those. This is like a mini research project so you won't get as long to research your topic and questions. So it has to be a bit more defined.

It is considered that most students who had participated in the study the teacher was referring to would have understood the terms used to describe the processes, with the possible exception of 'evaluation'. While most students would have understood the term 'mini,' some may not have been readily understood the term 'a bit more defined'.

A further example of the teacher using recall of related events to aid student understanding occurred during the introduction of surface and deep thinking to help differentiate between closed and open questions. The teacher intended to compare closed questions with surface thinking, in contrast to open questions that required students to think and investigate them more deeply, to consult a range of resources and to add their own views on the issue. The teacher asked the students to recall the teacher / parent / student interviews held several months previously.

> I haven't spoken about the levels of thinking for a little while. Pencils, pens down! We have what we call, or what I call, people who think on a surface level. If you think back to your mid-year interviews when I had, sometimes had you and your parents at mid-year interviews, I talked about surface level and deeper levels of thinking.

As with the previous example, the students would need to have been present at the interviews and to be able to recall some months later, the specific relevant content of the interviews. Given the complexity of the concepts and the context of the interviews which could have been a threatening or uncomfortable experience for some students, it is considered unlikely that those students who had attended the interviews would have been able to instantly recall any specific discussion related to surface and deep thinking. In addition, the concepts may only have been discussed with some students and parents, therefore the inability of some students to recall the discussion would have been genuine. Depending on their assessment of their own capacity for deep thinking, some students may have considered that the teacher's discussion of surface thinking did not apply to them and therefore the discussion was irrelevant and not worth attending to.

It is of interest to note the teacher's self correction from ... "when I had" to ... "sometimes had." This was due to the fact that some parents had refused to allow their children to attend the interviews, believing that the interviews should involve only the teacher and parent. This issue had been of sufficient concern for the teacher to raise it in the post-unit interview when discussing some of the constraints she felt on her practice due to parental beliefs and expectations. The teacher recalled one parent who had stated: "I don't believe in my children coming to interviews. It's a parent-teacher interview. It's got nothing to do with my child.... If you've got a problem with my son then you say and you fix it up because you're the teacher." This raises speculation in relation to the effects of the teacher getting the students to recall the mid-year interviews in this way. It is possible that those students who were not permitted to attend the interviews may have felt embarrassed at the time. Recalling the event in this way could have aroused negative emotions or feelings that they had been disadvantaged or had missed out on important information.

The teacher attempted to further clarify the relationship between surface and deep thinking and open and closed questions by giving an example specifically related to the Aztecs. During times 82-85 the teacher stated:

> Take an example. If we've got, chosen a topic rather about slaves and nobles. An open question might be along the lines of why are there different levels of people in the Aztec empire. Why? For what purpose? If you look in a book it might tell you what the levels are. Might tell you what they do, how they got there. But it may not necessarily tell you why. And it's going to require you to read about it. But then you're going to have to think deeply about it so you get the answer.

While it was appropriate for the teacher to use an example based on the Aztec topic, the example she used may have been beyond the comprehension of many of the students. At this stage of the topic the students had no prior knowledge of the structure of Aztec society and therefore no context in which to place the example.

An example of the teacher's use of simplification of terms occurred between times 19-20. As the teacher proceeded to read the instructions on the 'Skills Hand' sheet, she paused to simplify some of the statements.

> Identifying the issue, topic or problem to focus your questions. Well that's easy enough for most people. Just means choosing the topic you're going to research further. The second one, identify the key words to your study, issue or problem. In this case it's to your study.

The teacher then attempted to clarify 'keywords' stating: "We know all about key words. We used it in the information skills, the action learning that we did." It appears that the teacher was referring to a specific session or sessions on information skills and that these had been classified as action learning. As with the research process, the students' understanding would have been dependent on them having participated in the sessions. They would then have to be able to recall within 30 seconds, the relevant information skills sessions, to interpret them as action learning, and then make the links between action learning, information skills, and the processes involved in the question writing activity.

Frequency of teacher use of selected words

The teacher's language during the introductory phase of Lesson One was analysed for frequency of use of the words 'you', 'we', 'I,' 'who' and 'why'.

The teacher used the word 'you' 140 times. The frequency of the use of the word 'you' reinforced the teacher's instructions that students were expected to undertake the activity individually and independently. In a more general sense, the use of 'you' conveyed the teacher's expectation that the students were to take responsibility for their learning. An example of the use of 'you' occurred at time 90 when the teacher stated:

> You might find when you now look at some of your key questions that you wrote the other day that some of them you can use. But maybe you need to make some others so you have a balance between the closed and the open questions.

The teacher also used 'you' when prefacing her assumptions about what they should already know and understand, for example, "You should all know this."

The teacher used the word 'I' 38 times. 'I' was most often used as a directive, or when the teacher made a comment specifically related to her role. Examples include, "I want you to watch," and "I haven't spoken about the levels of thinking for a while."

The teacher used the word 'we' 22 times. While the use of the word 'we' may be considered to denote inclusiveness, the fact that the teacher used it far less frequently than 'you' may suggest that the teacher's focus is more on the individual than on whole class. The word 'we'

was also used when the teacher referred to specific events that students were expected to recall and relate to the question writing activity. For example, "We used it in our research," and "We've been going over and over and over."

The teacher used the word 'who' four times. 'Who' was used only once in relation to providing students with the opportunity to answer a content-related question. The other three uses of 'who' occurred in the context of discussions of who as a key word.

The teacher also used the word 'why' four times. All four instances were in the context of the discussion of 'why' as a key word. There were no instances of the teacher using why to elicit content-related responses from the students.

The minimal use of the words 'who' and 'why' is consistent with the limited amount of time spent by the teacher and students discussing content-related questions during the introductory phase of the lesson.

Teacher assumptions about students' existing knowledge and understanding

The words 'we' and 'we've' were used by the teacher in relation to the assumptions held about students' prior knowledge, experience and understanding of content, and of their ability to quickly recall previous relevant activities. During the 26 minutes introductory phase of the lesson, the teacher made eight comments demonstrating such assumptions, as illustrated in the following examples.

At time 21, the teacher discussed the need for students to use key words to focus their study. "We all know about key words. We used it in the information skills, the action learning that we did. You're going to use it again today." The teacher was assuming that all students would know about key words through using a similar approach in previous studies. She was also assuming that all students had been present during the previous information skills and action learning referred to, and additionally, that they would be able to instantly recall the activity and be able to relate it to the current question writing activity.

At time 25, immediately prior to selecting a student to respond to the question "What is the difference between an open and a closed question?" the teacher made the third assumption in 3.75 minutes about student knowledge and understanding. "You should all know this. We've been going over and over and over." While the teacher may have been using such comments to focus the students and to stimulate their recall of previous activities, the way in which the teacher prefaced the question with the comment, and the tone of her voice which emphasised the "over and over and over," may have been interpreted by those students who did not know

the answer had either not attended to the teacher previously, or were limited in their ability to understand the concept.

At time 52, the teacher made the assumption that students would understand her logical progression in procedures for setting out their work in the draft topic books. "Then if you're following what I'm doing in my logical order, you'd know that on the next page we're going to write open questions." Implicit in this comment is the assumption that the students understood the term 'logical' and that if they were following her instructions they would understand the order for setting out their work.

At time 86, the teacher made the assumption that the students would be able to evaluate their own thinking and then determine which category they were in. "Now there's a lot of people in here who can think quite deeply about questions, but there are also people who I would like to work on developing your deeper levels of thinking."

At time 97, one of the most confident students (Carly) sought clarification of whether to put questions beginning with 'what' under open or closed questions.

Carly: Um, with um some of the questions, some of them don't actually have like, begin with why or how. Or some of them, like what, what would that come under? Open or closed?
Teacher: It's written on your sheet.
Dexter: Or you could put why there.
Teacher: Remember this sheet here that we glued in? Have a look at that one. That explains it in quite a lot of detail.

Rather than provide Carly with a definite answer, the teacher chose to refer her back to the 'Skills Hand' sheet, implying that the students would have understood and remembered the relevant content of the resource.

Teacher assumptions about students' prior knowledge and understanding and the effects on student participation in the instructional phase of Lesson One

As demonstrated, the teacher made eight explicit assumptions about what the students' should have already known and be able to do in relation to the question writing activity.

By prefacing her questions with statements such as "It's easy enough for most people," "We all know what key words are," "You should all know this, we've been going over and over and over," the teacher was implying that all students were expected to know the answers.

From the limited number of content-related questions asked by the students, it may be argued that when a teacher makes assumptions or states explicitly what students should know, some students will be deterred from asking questions to clarify their understanding. As demonstrated in previous examples, the students who asked content-related questions were often not provided with definite answers. The teacher's responses of "It depends on your definition of open and closed," It depends on the question," "It could go in both," did not provide the students with the clarification they needed.

Post-unit interview data supports the contention that students who did not consider it to be easy are unlikely to admit to the teacher or their peers in a public forum that they do not find something easy that the teacher has explicitly stated should be "easy enough for most people." This is demonstrated in the following extracts from interviews with the subjects about their willingness to answer teacher questions and the resulting effects on their hand-raising behaviour in a whole class context.

Interviewer: What causes you to put your hand up in class?
Libby: I usually don't (laughs). Just if I'm sure about something then I put my hand up. But if I'm not I never put my hand up.
I: So on those times that you haven't put your hand up, is that because you haven't been sure?
L: I've kind of got an idea but I'm not really sure.
I: Do you mean you don't want to get the answer wrong for the teacher?
L: Yeah, I'm not really sure.
I: Some people answer wrong, is that OK or do you have to be right all the time?
L: I wouldn't want to be totally wrong, that would embarrass me.
I: Do you put your hand up much to answer questions?
L: I don't usually put my hand up, but like Carly, she's always putting her hand up.
I: If the same people are putting their hand up, does that have an effect on you?
L: Nope, because if I put my hand up I would usually get picked because it's different people instead of Carly and stuff.
I: So if you put your hand up there's a good chance you'd be asked, so you'd want to be really sure?
L: Yeah, unless like everyone put their hand up.
I: Do you think the teacher notices when different people put their hands up?
L: Yeah.

Libby's comments demonstrate her awareness of individual student hand raising and the teacher's response to it. Carly was a confident, assertive student who demonstrated a consistently high level of hand raising behaviour. She was successful in her attempts to interact with the teacher and was sufficiently confident to occasionally initiate interactions

before being invited to do so. Carly was unpopular with many of her peers due to her dominant behaviour, particularly during group activities. Although Carly always puts her hand up, Libby knows that the teacher is aware of this and that she notices when other students raise their hands. Libby also knows that because she raises her hand infrequently the teacher will notice when she does and that there will be a strong likelihood she will be selected to respond. Because Libby is not as confident as Carly, she is only prepared to raise her hand if she is confident her response is correct.

Rewa's post-unit interview responses were similar to Libby's.
Interviewer: What's it like for you in the classroom when the teacher's asking questions and people are putting their hands up to answer? Do you put your hand up much?
Rewa: I don't a lot but if I know something I will.
I: So the times that you don't put your hand up, what does that mean?
R: Um, sometimes I don't understand and sometimes I don't feel like putting my hand up.
I: What do you think it would be like to get asked a question and you get the wrong answer?
R: Well, sometimes it could be embarrassing or something, and sometimes it's just an easy mistake.

From Libby and Rewa's responses, it appears that the risk of possible embarrassment in front of their peers is a strong deterrent to raise their hands unless they are sure they are correct.

In contrast to Libby and Rewa, Rod, who is a very confident student with a high level of self-efficacy, raises his hand frequently in whole class contexts. Rod reports to use hand-raising as a way of alleviating boredom. The following extract is from an interview with Rod about a question he had answered about Aztec symbols that were described as being like hieraglyphics.
Interviewer: Why do you like raising your hand in class?
Rod: I'm a bit happier cos I've got something to do. Cos like I know the answer.
I: What's it like for you when your hand's up and you don't get asked?
R: A bit annoyed.
I: So do you like things to do with hieraglyphics?
R: Not really. It was just the first question I knew the answer to in the whole thing. I was bored so then I had something to do.

Rewa's response of "sometimes I don't understand" is particularly significant. If teachers select only those students who they consider will know the correct answer, valuable opportunities for correcting misconceptions held by less confident students may be lost. The establishment of a classroom climate in which students are encouraged to take risks, secure in the knowledge they will not risk embarrassment through censure from the teacher or their

peers for giving an incorrect response, may be a significant factor in relation to student hand raising behaviour.

There are possible alternative explanations for why the teacher chose not to provide definite answers to selected students' questions. It is of interest to note that two of the three students who did ask content-related questions (Carly and Dexter) were well known to be amongst the most confident, assertive students in the class. The teacher may well have considered that Carly was able to interpret the information from the sheet herself. This would be consistent with the teacher's stated philosophy of the benefits to students of answering their own questions, and being extended by taking increased responsibility for their own learning.

An additional, more practical consideration is that Carly's interaction with the teacher came after the instructional phase had been in progress for 25 minutes. The teacher may have considered it was preferable to refer Carly to the sheet of instructions, rather than take additional time to explain it again, thus risking further management problems with a restless class of students. The teacher did conclude by stating that both the trainee teacher and herself would be available to answer further questions and to assist individual students during the activity phase of the lesson.

Teacher instructions related to the individual nature of the question writing activity

The teacher explicitly stated the question writing activity was to be undertaken individually on five separate occasions as follows:

Time 36: Individual work, yes (in response to student question).

Time 39: The research is going to be individual for a start, so you're going to be going through these steps on your own.

Time 41: For the next week you'll be working on the research. Right through next week it will be individual, independent work.

Time 88: Alright, this is your independent research.

Time 103: I don't want you interacting with anybody else. I want these questions to be only your questions, not anybody else's.

The data demonstrates the specific nature of the teacher's instructions for students to undertake the activity individually. There were however two ambiguous, conflicting statements made in relation to the individual nature of the task. It should be noted that in the previous lesson on Day 6, the teacher had stated that students would be able to focus on their own selected aspect and carry out their research either individually or with other students who shared a common interest over the next two weeks. The statement made on Day 6 is in clear conflict with that made at time 41 on Day 7. Immediately prior to the instruction given at time 41, the teacher had stated: "When it comes to presentations later on, when we talked about

that, there will be the possibility that you can join up with other people on the same topic and then present what you have done, what you have found out."

Based on the teacher's comments made the previous day, and her comments at time 40 on Day 7, some students may have presumed that if they were going to be able to join with peers to present their research, it was therefore acceptable for them to collaborate while writing their research questions. Despite the teacher specifying that the entire following week was to be spent on individual research, it is of interest to note that as soon as the instructional phase was over, several students, including one of the subjects (Libby) managed to work collaboratively on their questions. Other students, including Ned and Rewa were unable to work with peers due to the proximity of the teacher to Rewa's desk for much of the activity phase of the lesson, and the location of Ned's desk, next to the teacher's desk, isolated from his peers who were all sitting in groups.

The significance of student non-compliance with teacher instructions to work individually on the activity will be discussed in Chapter Six.

Teacher questions related to content

The teacher asked a total of two content-related questions during the introductory phase. Five students were given the opportunity to respond. The total time spent by the teacher engaged in discussing teacher-directed content-related questions with the five students was 1.25 minutes. A description of the three questions and the students' responses follows.

Question One: Times 7-9

The first question related to the six aspects of Aztec life discussed in the previous lesson.

Teacher: Right, while those pieces of paper are being given out you tell me some of the six words we had a look at the other day. Who can give me some of them?

Carly: Communication.

Dexter: Farming.

Kirsty: Markets.

As the teacher had already written three of the six aspects on the whiteboard (temples, slaves and nobles, and warfare), the students were only required to recall three of them. Alternatively they could have given a correct response by simply reading the words recorded on their work sheets or from the teacher's list, thus eliminating the need for any recall.

Question Two: Time 24.

The second question was asked six minutes into the session and related to the difference between open and closed questions. Two students were selected to respond (Jed and Dexter).

Teacher: What's the difference between a closed question and an open-ended question? You should all know this, we've been going over and over and over.
Jed: The closed question is like we talked about (inaudible), told the people that um, it was like it's about something, and an open question's like yes or no or something.
Dexter: It's the other way around.
T: Just the other way around Jed. Not a bad definition, just needs to go the other way around. Dexter?
D: An open question's like where you go. It's like where you go, it's like lots of different things you could look up.
T: Yes.
D: Different answers. The closed question's yes or no.
T: Okay, so what you're saying in this study, or looking at designing these questions, have a mixture of closed questions. If you asked closed questions for a start they're going to give you factual answers. Then what you can do is ask some open-ended questions that help you think more deeply about an issue or a study, and ask some very inquiring type questions.

The confusion evident in the students' responses demonstrates that their understanding was well below the teacher's stated assumptions about what they should already know. Jed clearly did not understand the difference between open and closed questions. While the teacher was positive in her acknowledgement of Jed's attempt to answer, she did not provide the correct answer but simply agreed with Dexter that Jed's response needed to go the other way around. The teacher then asked Dexter to provide his definitions that were only partially correct. While Dexter understood that open questions could have more than one answer and required additional effort to find the required information, he demonstrated limited understanding of closed questions. These misunderstandings were not corrected or clarified by the teacher who simply stated "Okay" and continued reading through the sheet. The effects of the continuing misconceptions and confusion in student understanding on their ability to carry out the activity will be discussed in Chapter Six.

Student-initiated statements and questions related to content

In addition to the 1.25 minutes spent discussing the two teacher-directed questions related to content, the teacher spent 2.45 minutes engaged in discussion with three students about their own content-related questions or statements.

At time 51 one student (Lorraine) initiated a statement in relation to questions starting with 'who'. At time 23 the teacher had instructed the students to put questions beginning with 'who', 'when' and 'where' under the heading 'Closed Questions'. At time 29 she had instructed students to put questions beginning with 'what', 'why' and 'how' under the heading 'Open Questions'. The students were given three minutes to glue the resource sheet

into their topic books. Lorraine had obviously been thinking about what the teacher had said about 'who' questions and stated "Who questions aren't always closed questions." The teacher responded "No, I, yes, okay I understand what you're saying Lorraine."

The teacher gave no further clarification and continued to give both verbal and written instructions for setting out of key words in topic books. It is obvious the teacher had been considering Lorraine's comment while writing the instructions on the whiteboard, and she responded to it at time 54. "Right. Sometimes Lorraine's quite right. Sometimes a who question might be an open question, or the other, might be a closed question." The teacher's response is considered ambiguous and of limited value in providing the students with further clarification of the difference between open and closed questions.

Two students (Carly and Annabelle) asked a total of three content-related questions during the instructional phase. Annabelle asked the first question at time 56, approximately 14 minutes after the lesson started.

Annabelle: Which one would what come under?
Teacher: Depends on the question. What do you think?
A: Closed.
T: Depends if that what question had a very short answer, closed. It could possibly come under both.

There were no further student questions related to content for the next ten minutes until Carly asked her two questions at time 97.
Carly: What would that come under, open or closed?
Teacher: It's written on your sheet. Remember this sheet that we glued in? Have a look at that one. It explains it in quite a lot of detail.
C: So if I put that, would that come under open or closed?
T: Okay, you need to go back to the definition of what an open question is and what a closed question is. Closed question is usually a short factual answer. Open question – are you listening? Are you listening? Open question means you might look in a bit of detail and then also put down what you think.

The teacher's comment about the need to look "in a bit of detail" appeared to contradict her earlier statements related to the need to research widely and to think deeply about open questions.

In common with Lorraine, Carly and Annabelle wanted further clarification of how to classify questions, particularly those beginning with 'what' and 'that'. The teacher's responses to the

students were of limited value. At time 98 when the teacher did provide an unambiguous definition of a closed question, she was simultaneously attempting to manage the increasingly restless behaviour of the class. Due to the wide spread off-task behaviour of many of the students, it is questionable as to how many students would have been listening to the teacher or would have been able to follow her definition as it was interrupted by the reprimands.

In total, four of the 26 minutes introductory phase were spent by the teacher discussing content-related questions with eight of the 28 students in the class.

Teacher questions related to procedures for carrying out the question writing activity

The data shows the disproportionate amount of time spent by the teacher and students discussing issues related to procedural matters. In contrast to the four minutes spent discussing content-related matters, the teacher and nine students spent a total of 6.75 minutes discussing 30 questions related to procedural matters.

The teacher asked a total of 13 questions related to procedural matters for carrying out the activity and the distribution of resources. The questions took 2.5 minutes of the 26 minutes phase. The questions were of a general nature, for example, "Will you hand these out?"

Of particular interest is the question asked by the teacher at time 88. "So what do you have to do today?" None of the students responded, despite the fact that the instructional phase had been going for 22 minutes and was drawing to a close. The teacher immediately answered the question herself, stating the time available to carry out the task (30 minutes) and the need for students to make a firm decision on their topic and to look at key questions they have written in case they need to add to them. The lack of student response to the question may have indicated a lack of confidence in their understanding of the activity and that they were unprepared to demonstrate this in front of the whole class. Alternatively, due to the restless nature of many of the students, the teacher may have been unprepared to spend additional time waiting or having to correct an incorrect response.

Student questions related to procedures for carrying out the activity

Nine students asked a total of 17 questions related to procedures for carrying out the activity. The questions took 4.25 minutes of the instructional phase. Examples of the students' questions and the teacher's responses include:

Mel: Do we decorate them?

Teacher: Don't want them decorated.

Dexter: This is individual work isn't it?

Teacher: Individual work, yes.

Ashton: Do we put titles?

Teacher: Don't need a title, just your name.

Denzil: Can we trim it?

Teacher: If you want to.

Dexter: Do we do it on the newsprint side?

Teacher: I don't mind which way you put it up.

Jed: Do you write the questions down on an open and closed page?

Teacher: Yes, I would love you to do that. That would be superb. Okay, superb!

An analysis of the procedural questions asked by the students demonstrates their concern with those aspects of the activity related to setting out and general presentation of their work. Despite the teacher's reassurance that the newsprint booklets were only for recording draft material, the students' primary concern was not with what to write in terms of content, but with doing titles, decorating the pages, and trimming the edges of the 'Skills Hand' resource sheet. The teacher's response to the final question asked by Jed demonstrates the teacher's exasperation. While she was trying to be humorous in her response, the question was asked at time 101. By this stage the instructional phase had been going for over 25 minutes and the majority of the students were very restless. The teacher was aware of this and wanted to dismiss them to start the activity.

Student preoccupation with the presentation of their work, rather than the content, was common across all studies in the Project on Learning. This is particularly true of work that was to be displayed publicly or written in books that would be taken home to show parents. Observations show that it is common practice for teachers to spend the first few minutes of the first lesson of a typical social studies and science topic, introducing the topic, with the remaining time spent by students designing and decorating a title page. Students' primary concern with presentation of their work may be a reflection of their accumulated experience over five years of schooling with evaluation procedures that focus on presentation rather than content. Students may have learned that it is the more superficial aspects of an activity that are most likely to noticed and commented on by their teachers, parents, and peers. The issue of those aspects of activities that are perceived to be of importance to students is discussed further in Chapter Eight.

Teacher language when acknowledging students' interactions

As demonstrated in previous examples, the teacher consistently provided definite responses to students' questions related to procedural matters, often adding clarity by incorporating the same words used by the students in their questions. In contrast, there was limited evidence of the teacher providing definite answers to content-related questions. In response to four content-related questions asked by students, the teacher gave one definite response, followed by an example. Teacher responses to the other three questions were indefinite, or potentially

confusing, for example "No, I, yes, okay, I understand what you are saying." The teacher used certain general words such as "okay," "yes," "thank you," and "right," as a way of acknowledging student responses. At times, the teacher did not respond to an answer. As a result, students could have been left with the impression that partially correct or incorrect responses were in fact correct.

Teacher language related to management of students

The teacher made a total of 19 requests for students to listen and pay attention during the instructional phase. The requests were made within 16 separate fifteen minutes intervals as follows:

Time 19 – Pencils down please. I want you listening and following as I'm reading.

Time 22 – Pencil down, pen down and listen.

Time 40 – Wait.

Time 42 – Listen Toby.

Time 47 – Hold on.

Time 68 – Quickly please.

Time 70 – Thank you. Now watching this way please.

Time 71 – I just want you watching.

Time 72 – Quickly Jack.

Time 73 – Quickly please.

Time 76 – Listen. Excuse me Randal.

Time 78. I want you listening Elle please.

Time 79 – Elle, put it down.

Time 81 – Marsden.

Time 92 – Wait.

Time 98 – Are you listening. Are you listening?

The first two requests were made immediately prior to the teacher starting to go through the 'Skills Hand' sheet while some students were still writing their names on their sheet. The next three requests made between times 40-47 demonstrate the students' eagerness to start gluing their sheets in to their topic books while the teacher was still giving instructions. As demonstrated, the teacher often used the strategy of naming and making an example of an individual student to manage whole class behaviour rather than issuing a general reprimand to the whole class.

A significant number of requests (13 of the 19) occurred between times 67-99. At time 67 the instructional phase had been in progress for 17 minutes and the class was becoming increasingly restless. This was particularly evident in the behaviours of the four subjects during the last ten minutes of the instructional phase. The subjects, in common with most

other students in the class, all demonstrated high rates of fiddling and other behaviours such as looking out of the window, rubbing eyes, playing with scissors and scraps of paper, looking at the clock. The behaviours of the individual subjects during the instructional phase are discussed more fully later in the chapter.

Teacher requests for attention during the four minutes discussion phase at the end of the lesson

The teacher made the following additional three requests for students to pay attention during the discussion phase that took place in the last four minutes of the lesson.

Time 195 – Right I'd like you sitting in your desks please.
Time 196 – Hurry up please. Put your hand up if you can hear me. Hand on your head if you can hear me. And hand down if you can hear me.
Time 197 – Quickly. You should have your booklet open. Come on Pat and Hy, come back please.

These requests for attention used approximately one full minute of the four minutes allocated to the final discussion phase of the lesson.

Students' responses to teacher requests for attention

The following interview data shows that students are selective in their responses to the teacher's requests to pay attention, particularly when requested to raise and lower their hands or place their hands on their heads to show they are listening.

Interviewer: What happens if you don't put your hand up to show you are paying attention?
Rod: Oh well, it wouldn't really make much of a difference if you didn't do it because most people don't put it up anyway.
Ned: Sometimes I do it and sometimes I don't. Oh, I hear her but sometimes I just don't want to.
I: Is there a penalty for not putting your hand up?
N: No, but sometimes first thing in the morning she'll say "Let's try that again."

The students' comments suggest that they have learned the teacher is inconsistent in her insistence on their compliance and that there are no penalties imposed for non-compliance.

Effects of student interactions during the instructional phase of a lesson on opportunities for cognitive engagement and perceived social status within the class

The opportunities for students to interact with the teacher and peers and participate in the instructional phase of a lesson raises some important issues for consideration in relation to opportunities for cognitive engagement with the related concepts and on the enhancement of the social status, confidence, and self esteem of individual students.

The above data demonstrates the disproportionate number of times one student (Dexter) interacted with the teacher. Within the first two minutes of the lesson, Dexter was one of the first students selected to respond to a content-related question. His correct response demonstrated his interest and attention. He was also given the opportunity to correct another student's response. Although his response was only partly correct, the teacher affirmed it by stating "Okay."

Within the first seven minutes of the instructional phase, Dexter had established a profile with his peers and the teacher as being one of the most knowledgeable about the content of the activity. Dexter continued to demonstrate his interest and subsequently succeeded in being given six additional opportunities to ask questions related to procedures for carrying out the activity.

When one student out of 28 is given the opportunity to interact with the teacher for approximately one third of all teacher-student interactions over a 26 minute phase of a lesson, that student is likely to benefit in a variety of ways. The student is afforded more opportunities than their peers for cognitive engagement with the concepts. They are able to publicly demonstrate their knowledge and to have their understandings confirmed. Of equal importance is the opportunity for them to have their misconceptions corrected. The resulting development of a high profile within the class may enhance the student's self esteem, increase the student's confidence in their own ability to carry out the activity, and heighten their social status amongst their peers.

It may be argued that by the end of the instructional phase, the perception of other students was that Dexter clearly understood the content and instructions for the activity, thereby establishing him as an 'authority'. This positive image may result in students like Dexter being regarded as preferred partners or group members, able to assist others, and to take leading or authoritative roles in group activities. In this way, enhanced opportunities for individual students to display their knowledge in a public forum may perpetuate the social hierarchies that exist in classrooms.

The following example shows that given a choice, students will choose to work with peers who they consider to be capable, or in their words "brainy."

Interviewer: Do you think children of your age, when working in groups and you're asked to discuss things, do you think you stay on task pretty well and talk about what you're supposed to?

Jack: Yep. It's just that most of my friends are pretty brainy. Rod and Jeff, they're quite brainy. Rod is really brainy.

I: Where do you think he gets all his knowledge?

J: Probably the news, he might watch that.

While Rod may well be an able student, Jack was unable to specify why Rod was so "brainy." Like Dexter, Rod also enjoyed a high profile within the class and was observed to frequently raise his hand and successfully engage with the teacher at a high rate. As a result, Rod was given numerous opportunities to display his knowledge publicly, which may account for Jack's perception of him as being "really brainy."

Rod's high level of self-efficacy and perception of his superior ability is demonstrated in the following extracts.

Rod: If there's one thing I'm good at its maths. I'm good at lots of other things too.

Interviewer: Do you think you are clever?

R: Yep. I just know, cos like I do. I'm better than anyone else. I like being better cos you get like less work cos you finish it quickly and can go to lunch earlier.

I: How do you feel when you have done something well?

R: I'm just happy, like when I've really done something good.

I: What's your level of thinking?

R: Probably deeper.

I: Do you think everyone can think at a deep level?

R: Yeah, but sometimes they just choose the surface level cos like they can't be bothered cos they think it takes up too much brain power. Deep thinking's better cos like you're learning more.

Rod's self-appointed authority and dominance in group situations is confirmed by him in the following interview extract.

Interviewer: How did your group get on with the activity?

Rod: I did most of the work cos the others were just being silly. Sometimes I don't like what other people do. They don't listen to me so I just do the work for myself. Then they complain that I'm not letting them do any of the work and I say well you're being silly. If you don't stop being stupid I'll kick you out of the group.

It is acknowledged that a high rate of teacher interaction with one student does not necessarily indicate favouritism or poor teaching practice. Teachers in the studies stated consistently their awareness of the need to give their students equal opportunities to participate in whole class discussions. There are several factors that may impact on the extent to which an individual student is selected to respond. These include the following: the interest and level of engagement of individual students; the willingness of students to raise their hands; their history of responding in whole class contexts; the time available; the sensitivity of the teacher

in selecting students whom they consider will respond correctly, and the proximity of the student to the teacher.

4. Characterisitics of individual learners

In this section of the chapter, analyses of the individual subjects' experiences of the introductory phase of the lesson are presented.

Summary of subjects' behaviours during the 26 minute instructional phase of Lesson One

Table 12 provides a summary of the individual subjects' behaviours during the 26 minute instructional phase of the lesson. The totals represent the number of 15 seconds intervals each subject was observed to engage in the specified behaviour. The subjects may have engaged in more than one behaviour in a single interval.

Table 12

Summary of subjects' behaviours during the 26 minutes instructional phase of Lesson One

Behaviour	Rewa	Libby	Rod	Ned
Hand raising (content related) Hand raising (non-content)	2	1	1	3 2
Fiddling with personal items, paper, writing material	22	46	21	23
Yawn	0	3	3	0
Gazing out of the window	0	8	0	0
Talks to teacher	0	0	0	1 (1 call out Ignored)
Talks to peers (content related)	0	0	0	1
Talks to peers (non-content related)	7	9	3	7
Writing in topic booklet (copying teacher information from white board)	14	13	11	15
Gluing sheet into topic book	12	10	9	12
Looking at question writing resource sheet	10	4	19	6

The behaviours exhibited by the subjects as shown in Table 12 were representative of many of the students in the class. Most students managed to glue the 'Skills Hand' resource sheet into their topic books within the allocated time. The teacher had originally implied that the instructional phase would last about ten minutes. As the instructional phase proceeded, there was an obvious and wide-spread loss of focus with several students engaging in a range of off-task behaviours, for example doodling on worksheets, reading unrelated material, and

gazing around the room. Particularly evident was the excessive amount of behaviour that involved fiddling with personal equipment such as pens, pencils, pieces of paper, hair and other small items. The general restlessness was particularly pronounced in the last seven minutes of the instructional phase as confirmed by the number of reprimands and teacher requests for students to listen and pay attention. Of the 16 reprimands issued by the teacher during the 26 minutes instructional phase, 10 were given in the last 7.5 minutes.

Individual subjects' experiences of the instructional phase of the lesson

Rewa.

Observations during the instructional phase showed that Rewa appeared to be listening but not with any apparent interest. Rewa raised her hand in response to one teacher question only. This question did not require students to risk giving the incorrect answer as they had the required information in front of them. She was not selected to respond. The only social interaction Rewa had during the 26 minutes was non-content related discussion with her peers while gluing resource sheets into their topic books.

Rewa exhibited fiddling behaviour during 22 intervals throughout the instructional phase. Although Rewa reports to be able to listen while she is fiddling, Rewa's rate of fiddling behaviour and her comments in the interviews confirm that she was feeling bored. Rewa stated that she finds it difficult sitting listening to instructions for long periods of time, particularly when the instructions are perceived to be difficult.

Rewa looked at the 'Skills Hand: Designing Questions' sheet during ten 15 seconds intervals. Other than taking three minutes to glue the resource sheet into her booklet, the only activity Rewa was involved in was copying the teacher's model of how to head up the pages in her topic book from the white board. She was copying this information during 14 time intervals.

Rewa's limited understanding of the difference between open and closed questions and deep and surface thinking indicates that she was absorbing little of what the teacher was saying. During the post-unit video-stimulated recall interviews, Rewa was shown a video clip of the lesson segment where the teacher was explaining the difference between deep and surface thinking.

Interviewer: So what are you feeling there.
Rewa: Probably bored.
I: Now what about deep and surface level thinking. What are they?
R: Don't know.
I: Do you think you do deep or surface level thinking?
R: Don't know.

I: Did you do open or closed questions? What are they?

R: Mmm. Um, I think they are like questions like um you can change the answer and ones that you can't change the answers...I think it's closed you can only have one answer and open can like be two.

Interviewer: Is it sometimes hard to sit and listen to instructions?

Rewa: If they're pretty long it's pretty hard.

During the post-unit interviews the subjects were asked specific questions in relation to fiddling behaviour.

Interviewer: What's it like for you when the teacher's giving instructions for the day or the session?

Rewa: It sometimes gets boring.

I: And what do you tend to do when you get bored?

R: Just fiddle.

I: Sometimes the teacher asks people to stop fiddling. I wonder why she does that?

R: I think she says it because she thinks that we're not listening.

I: So do you think fiddling stops people listening?

R: Well, if the teacher's saying something really really boring sometimes it could, but it doesn't happen with me.

Rewa also stated that some children might fiddle because they are nervous.

At the end of the instructional phase Rewa was not well prepared to undertake the activity. She had selected an aspect of Aztec life to study (markets) but had not written the required keywords.

Libby

Libby was observed to be attentive and to listen to the teacher for the majority of the instructional phase, apart from two separate one minute intervals when she sat gazing out of the window (times 35-38, 77-80). She raised her hand to respond to one of the teacher's questions but was not selected to respond. The only social interaction Libby had during the 26 minutes was to talk to her peers about non-content related issues during the time allocated for students to glue the sheets into their books. She looked at the 'Skills Hand: Designing Questions' resource sheet during four 15 seconds intervals. Libby copied the required information from the white board during 13 time intervals. Libby demonstrated an excessive rate of fiddling behaviour during the last six minutes of the instructional phase when she continuously fiddled with a piece of paper.

In post-unit interviews, Libby also confirmed that fiddling usually indicates she is bored. For Libby, there appears to be degrees of boredom.

Interviewer: What's your theory on why people fiddle with things when they're sitting listening.

Libby: I don't know, bored or something.

I: What is it about being bored that makes people want to fiddle?

L: Sitting still would just be dead boring.

I: So what does fiddling do to that bored feeling?

Libby: Takes it away a little.

In common with Rewa, Libby commented that she could still listening while fiddling and that there are different levels of fiddling. "Usually if you don't fiddle that much you're probably listening". When shown a video clip of a student lying with his head on his arms while fiddling with a pen, Libby stated "He's probably not listening much because he just looked that way and he's drawing and stuff."

Rod

Rod was observed to be appropriately engaged, watching and listening to the teacher throughout the instructional phase. He raised his hand once to respond to a teacher question related to content but was not selected to respond. Rod only spoke to peers about non-content related issues during three intervals while gluing the sheet into his book. He looked at the resource sheet during a total of 19 fifteen second intervals. This rate is considerably higher than for any other subject. Rod spent 11 time intervals copying the required information from the white board into his book. Rod's rate of fiddling behaviour (during a total of 21 intervals) was comparable to that of Rewa and Ned.

Rod's post-interview comments in relation to fiddling were consistent with Rewa and Libby's. Rod differentiated between fiddling and boredom, regarding fiddling as the physical manifestation of boredom.

Rod: You really only fiddle when you're bored.

Interviewer: And yet you still answered the question. So the fiddling didn't stop you paying attention?

R: No, I just didn't pay as much attention as I could have.

I: Do you think it's the fiddling that causes you not to pay attention?

R: No, it's just probably being bored.

Ned

Ned raised his hand three times in response to teacher questions but was not selected to respond. He asked the teacher one question related to organisation. He also attempted to engage the teacher by calling out but was ignored and did not persist. He spoke to peers about

non-content related issues while gluing his sheet into his book. In addition, Ned spoke to a peer once about content, specifically related to the correct words to write for closed questions. Ned copied the teacher's information from the white board during 15 time intervals, and spent the full three minutes gluing his sheet into his book. He looked at the 'Skills Hand: Designing Questions' resource sheet during six 15 seconds intervals. Ned's rate of fiddling behaviour (during 23 intervals) was comparable to Rewa and Rod's.

As Ned had been absent in the previous session (Day 6), he did not have a map sheet, nor was he aware of the six aspects of Aztec life that students had been considering for their research. The teacher gave him a map sheet at the beginning of the instructional phase. Ned immediately started to read the sheet and write on it from times 5-15. During this time the teacher was instructing students how to use the 'Skills Hand' sheet. Observing Ned to be writing on the map sheet and without stopping what she was saying to rest of the class, the teacher pulled the correct sheet out from under Ned's map sheet indicating non-verbally that he should be following her instructions. Ned had clearly wanted to catch up with the rest of the class, while the teacher wanted him to follow her present instructions.

Due to his absence the previous day, Ned was unprepared to undertake the activity independently. He had not selected an aspect to write keywords or questions about. As his attention during the instructional phase was directed more towards looking at a copy of a map given to students the previously day, than to the 'Skills Hand' sheet, he had missed much of the teacher's initial discussion in relation to the activity requirements.

In the post unit interviews Ned made several comments relating to boredom and his use of fiddling to alleviate it.
Interviewer: If something is really boring, are you able to do anything to change it?
Ned: Ah, fiddle.
I: And what does the fiddling do the boring?
N: Oh, just something better to do.

In common with the other subjects, Ned maintained he could still listen and fiddle simultaneously. Viewing a video clip of him fiddling with a piece of paper, the interviewer asked Ned "Were you still able to have enough attention to hear what she was saying?" Ned responded "Yeah, I was just listening and fiddling."

From the consistency of the subjects' interview responses as to why they fiddle during classroom lessons, it may be argued that fiddling type behaviour denotes boredom. Fiddling was their way of alleviating the boredom by introducing some form of stimulation into their situation.

The data suggests that when the instructional phase is predominantly teacher dominated, with limited opportunities for student input or interaction with the teacher or peers, students are likely to lose focus and will engage in behaviours that distract their attention from the teacher's instructions and discussion. In addition, when the length of an instructional phase of a lesson is considered to be excessive, the resulting restless behaviours demonstrated by some students will present the teacher with additional concerns related to classroom management.

Summary of what students were required to know at the end of the instructional phase to successfully undertake the question writing activity

Based on the analysis of explicit teacher instructions, it is presumed that students who had the prerequisite skills and understanding of the activity, and who had been attending to the teacher would have understood the following requirements:

- to select one of six teacher-nominated aspects of Aztec life on which to base their individual research;
- to identify key words in relation to their selected aspect;
- they could change their selected aspect but that they would have to do that within the specific ten minutes allowed by the teacher;
- to set out their questions in their draft topic books (one question per page);
- to include a mixture of open-ended and closed questions;
- to complete the task within 30 minutes;
- to write their questions individually and without collaboration with peers.

Summary of what the teacher expected the students to know at the end of the instructional phase

In addition to the above points, the teacher expected the students to know the following:

- the difference between open-ended and closed questions;
- the difference between deep and surface thinking and how they would classify themselves as either deep or surface thinkers;
- the relationship between the question writing activity and related activities previously undertaken.

In summary, it is considered that the length of time taken to give the instructions, and the inconclusive answers given by the teacher to a number of the students' questions about the activity, compromised the effectiveness of the instructional phase for many students. At the conclusion of the instructional phase there were obvious continuing confusions and misconceptions held by the students in relation to the difference between open-ended and closed questions, and of the procedures for setting them out in their topic books. Due to the

limited detail given by the teacher regarding the way that the research would ultimately be presented and evaluated, the students appeared to have limited understanding of the overall purpose of the activity or of its significance to the research process.

The extent to which the subjects and other students understood the instructions and were prepared to undertake the activity is discussed in Chapter Six.

Analysis of the introductory phase of Lesson Two, conducted on Day 6 of a science unit on Kitchen Chemistry

1. Teacher planning and organisation of the introductory phase

Structure and purpose of the introductory phase

The introductory phase of the lesson was conducted in a whole class context in the first 18.25 minutes of the 49 minute lesson. Students were seated at their own desks for the duration of the introductory phase. In addition, students were called back into the classroom between times 94-106 to receive an additional 3.25 minutes of instructions for carrying out the activities correctly. At the conclusion of the activity phase, the teacher spent a further 1.75 minutes giving instructions for the report writing activity. In total, 23.25 minutes of the 49 minutes lesson was spent on the introductory and instructional phases.

Table 13

The sequence of events during the introductory and instructional phases of Lesson Two

Time	Event	Total Interviews	Minutes
1-4	Waiting for students to settle	4	1.0
5-13	Whole class revision of previous lesson	9	2.25
14-73	Discussion of concepts and activity instructions	60	15.0
94-106	Further instructions to whole class	13	3.25
176-182	Instructions for report writing	7	1.75
	Total	86	23.25

The introductory phase of the lesson was used for the following purposes:

- whole class revision of concepts from the previous lesson;
- introduction of new concepts planned for the lesson through discussion, questioning, and encouragement of student predictions;
- to give students instructions for undertaking the activities;
- to engender student interest and engagement, and provide motivation to carry out the activities.

A description of each purpose follows.

Whole class revision of concepts from the previous lesson

The first 3.5 minutes of the instructional phase were spent on general revision of concepts from the previous lesson. The teacher selected students to read aloud the statements they had written during the previous lesson. There were some statements of relevance to the task planned for this session. At time 12 one student stated: "The name for carbon dioxide is Co2". At time 13 another student stated: An acid – vinegar, and a carbonate – baking soda, put together form carbon dioxide". These statements provided the exact information required to answer post-test Item 19, as well as background information for Item 16. Two of the subjects raised their hands and were selected to read their statements to the class.

Jack: Acids are not only liquids.

Elle: Instead of spelling Mississippi the normal way, scientists spell it this way – MIS2IS2IP2I.

Introduction of new concepts through discussion, questioning, and encouragement of student predictions.

The teacher used the instruction and discussion phase of the lesson to introduce the new concepts planned for the lesson. The primary concept related specifically to the chemical reaction produced as a result of mixing an acid and a carbonate. The pop-gun and boat activities were selected to demonstrate this concept using baking soda and vinegar. If completed successfully, the students would see the tangible effects of the resulting build up of pressure from the chemical reaction. In the case of the pop-gun experiment, this effect would be demonstrated by the ejection of the cork from the bottle. In the case of the boat experiment, students would observe the effect as the boat was propelled through the water. The concepts of saturation and optimum point were also included with the teacher highlighting the need for students to measure the correct ratios of ingredients to produce the desired reaction.

The teacher used whole class discussion and questioning to introduce the concepts and to encourage students to make predictions related to the concepts. The primary concept was introduced at time 21 when the teacher asked students if they knew how to make a chemical pop-gun. The simplicity of the activity was implied.

Teacher: Put up your hand if you can tell me how to make chemical pop-guns first. I don't think it needs an Einstein to work this one out.

Jed: You put a bit of mixture in a coke bottle, or any other bottle, and then you put um.

Teacher: Ssssh!

Jack interrupts: Baking powder.

T: No it's not Jack.

Jed: Baking soda.

T: Thank you.

The mixture Jed was referring to was vinegar but he did not specify this. He knew that another ingredient was required but he was unsure of what it was.

Jed continued with his response becoming animated as he described the explosive effects of the reaction.

Jed: And you quickly put the cork on and bang! And then it goes bang! And you shake it up and then it goes bang!

Boy: Bang!

Teacher: Just wait please. Is there anybody that thinks Jed's left something out?

Toby: It's what would cause a chemical reaction. Putting pressure on causes it to form a gas.

Annabelle: It gave off carbon dioxide.

It is unlikely many students heard these responses due to the excessive noise level in the class.

The concept of saturation and the need to add the correct ratio of ingredients followed, with the teacher asking students to recall previous experiments to help them to predict how much baking soda they would need to add.

Teacher: Now, how much baking soda do you think we would need? You have a careful think about some of the reactions we've done, especially with the vinegar and the baking soda. How much baking soda do you think you might need? What would a benchmark be?

Jack: About a teaspoon or so? Teacher: Right. Rod?

Rod: Maybe about a tablespoon.

T: OK. That's pretty good. About a tablespoon or three teaspoons.

The teacher then emphasised that there was no need to shake the bottles. At this point Jack again interjected by miming an explosion as he spontaneously shouted out "Just goes boom." The teacher responded with a reprimand and a request for students to pay attention.

Prior to dismissing the students to carry out the activities, the teacher again emphasised that there was no need to shake the bottle by asking the question "Why do you not have to shake the bottle?" Jed was again selected to respond. This may have been intentional on the teacher's part to give Jed the opportunity able to build on his prior response and further clarify his understanding. "Because the chemical...the carbon dioxide mixes into it and makes power."

Elle was selected to provide another reason' stating "Because the baking soda works its way into the vinegar and it can start making the carbon dioxide." There was no further discussion related to the new concepts during the instructional phase of the lesson.

Use of the instructional and discussion phases of the lesson to give instructions for carrying out the activities

Instructions for carrying out the two activities were given following the whole class revision of concepts from the previous lesson. The instructions were interspersed throughout the remaining 12.25 minutes of the instruction and discussion phase. While giving the instructions for the activities, the teacher simultaneously engaged the students in discussions related to the possible chemical reactions that might occur as a result of mixing an acid and a carbonate. In addition to questioning the students and encouraging them to make predictions, the teacher recalled two incidents related to previous experiences of carrying out the pop-gun activity. As a result, the instructions for carrying out the activities were not given in discrete sets or in one specific part of the instructional phase of the lesson.

Second instructional phase (times 94-106)

Students were recalled into the classroom while the teacher briefly discussed why the pop-gun experiments were not working. The students were very reluctant to stop their experiments and it took the teacher two full minutes to get the students settled and paying attention. During this brief second instructional phase, the teacher questioned the students about why the pop-guns were not working. A brief discussion followed about the need to add the correct amount of ingredients and to ensure the corks were the correct size for the bottles. The teacher very briefly asked the students working on the boats about their progress.

Provision of instructions for report writing (times 176-182)

The instructions for the report writing activity were very brief. The first minute was spent waiting for the students to settle and listen. The teacher stated "What I want you to do please, is to write down at least two sentences of something else you've learned today." One student asked a seemingly obscure question "Do we put it under our own or someone else's or what?" The teacher demonstrated her understanding of the question by responding "Just in your own."

Methods of giving instructions for the individual activities

The teacher used a combination of verbal and written instructions for the two activities. As previously stated, rather than being given in sequence, or as a discrete set, the instructions for making the pop-guns were interspersed throughout a general discussion of the chemical reaction that occurs when an acid and a carbonate are mixed. There were significant differences in the way the teacher used the instructional and discussion phase to introduce, discuss and give instructions for carrying out the two separate activities. These differences are illustrated in the following descriptions of the way in which the teacher introduced each activity and gave instructions for carrying them out.

Instructions for the chemical pop-gun activity

The teacher spent 4.5 minutes of the 12.25 minutes instructional and discussion phase giving instructions for the pop-gun activity. The teacher introduced the chemical pop-gun activity first. When introducing the activity, the teacher encouraged the students to make links between previous relevant experiences of chemical reactions by thinking of other experiments that had been conducted in preceding lessons. Students were encouraged to make predictions about what they might expect to find as they conducted their respective group experiments. During the ensuing discussion, the teacher simultaneously questioned students about the required quantities of ingredients for making the chemical pop-guns while writing the following instructions on the whiteboard.

Chemical Pop-Guns

1/3 vinegar

1 tbsp baking soda

cork

The teacher discussed the chemical pop-gun activity in a novel way by describing her personal experience of conducting the experiment in her own kitchen that morning. The teacher highlighted the ensuing explosion causing the cork to hit the ceiling.

Teacher: "When I put the cork in this morning (at home), I did press it in quite far. It was about three- quarters of the way in. And I thought I'd pressed it too far and I just left it, and it still managed to pop up. That's probably the force of it that hit the ceiling...and you'll see the vinegar still on the ceiling from my experiment this morning."

The teacher's use of recalling her own experience was successful in engaging the attention of the students, many of whom demonstrated their amusement at the story by smiling, glancing up at the ceiling, or whispering to each other. Their interest was further heightened when a student interrupted the teacher calling out: "In Jack's eye! In Jack's eye!" This comment was made in relation to another student's experience of the activity. One of the subjects (Jack) had experimented with the activity in the classroom that morning and the ejecting cork had narrowly missed his eye. The teacher used the incident to emphasise the need for safety when conducting the experiment stating:

> We had a very unsafe thing happen this morning. The problem was someone was standing too close to the bottle. The other problem was somebody wasn't thinking clearly about chemical reactions and put the cork back on top of the bottle while I wasn't here. Just because it has exploded once and the cork's popped off doesn't mean that it still hasn't got carbon dioxide in it and it can do it again.

Rather than taking the story as a warning to conduct the experiment safely, the students found this incident amusing, laughing and looking at Jack while the teacher was talking. Jack clearly enjoyed the attention of his peers and became very involved in the discussion, attempting to respond to the teacher's questions, calling out responses when not selected by the teacher, and talking to his peers. The teacher told the class it would take a couple of minutes for the cork to eject, and warned them to make sure everyone was standing well back from the bottles. While the teacher was talking, Jack was engaged in his own parallel conversation with his friend. Jack disputed the teacher's estimation shaking his head and whispering: "About ten seconds." He then demonstrated exploding noises. In a show of bravado at the teacher's caution to stand back, Jack whispered: "I'll stand up close. Don't worry, it doesn't hurt." Later in the discussion, Jack further capitalised on the attention of his peers and his prior experience of the task stating: "That was so fun getting hit in the eye."

In addition to promoting the pop-gun activity as exciting, with implied elements of possible risk and danger, the teacher made a number of comments during the instructional phase that gave students the impression the pop-gun experiment would be relatively simple to conduct. Before giving the actual instructions for making the pop-guns, the teacher's comment "I don't think it needs an Einstein to work this one out," implied that the students should find the activity easy. The teacher concluded the instructions for the pop-gun activity by emphasising the simplicity of the instructions stating "The first thing I'd like you to do is make sure you read the instructions. The instruction for the chemical pop-guns is really simple. It's on the board."

Before giving instructions for the boat activity, the teacher reinforced the fact that students did not need to shake the bottles to get a reaction.
Teacher: You don't need to shake it up. All right? If you shake it up you'll just get a bigger mess probably, and we don't need that. One student interjected "Ceiling" to which the teacher laughed and said "Like the ceiling. I didn't shake it up!"

The instructions for the pop-gun activity concluded in a humorous way, emphasising the potential fun and excitement students could expect from conducting the experiment. The fun element was further emphasised by the teacher's statement immediately prior to the students moving into groups to conduct the experiments. "Of course this is designed for you to have some fun while you're doing it." As a result of the stories and class discussion, a number of students were clearly excited and motivated to start the activity.

Specific instructions provided for making chemical pop-guns

Specific verbal instructions given for making the pop-guns are summarised as follows:

- quantity of baking soda required – one tablespoon or approximately three teaspoons;

- quantity of vinegar required - one third of a bottle;
- the bottles should not be shaken once the ingredients have been added;
- the corks should not be pushed into the bottles too hard;
- the instructions should be read before starting;
- the experiment should be conducted safely.

Instructions for the boat activity

The teacher spent 1.5 minutes of the 12.25 minutes of the initial instructional and discussion phase of the lesson giving instructions for carrying out the boat activity. The instructions for the boat activity were given immediately after the instructions for the pop-guns. In contrast to the novel way in which the pop-gun activity was introduced, the teacher introduced the boat activity by simply stating "When you're making the boat, the instructions are here. It is very similar to the idea of the chemical pop-gun." The verbal instructions for the activity were very brief. The teacher instructed the students how to cut the hole in the bottle and to insert a straw in the hole. The need to make a seal around the straw out of blue tack was discussed. The teacher then instructed the students to put the required amount of baking soda in a folded tissue along with vinegar. Students were finally instructed to place the cork in their bottle and observe the effects. The need for the straw to be placed below the surface of the water was stressed.

While giving verbal instructions, the teacher simultaneously gave a superficial demonstration of some aspects of the required steps in the construction process. This demonstration consisted mostly of the teacher holding up the materials rather than explaining the more technical details of the required construction. No opportunities were given for students to ask questions. The teacher asked only one concept related question while giving instructions for the boat activity.

Teacher: Why would you need to seal around the straw?
Moses: So the water doesn't get in.
T: Yes. And another reason?
Jack: So the gases and all that don't go out too fast.

The teacher concluded the instructions for making the boat stating: "Hopefully your boat will move along. Hopefully." This last comment gave the impression that the boat activity may not be successful, in contrast to the almost guaranteed 'explosive' outcome expected from the pop-gun activity.

Immediately after giving the instructions for making the boat, the teacher briefly asked all groups to read the instructions for their respective activities. In comparison to the comments

about the simplicity of the instructions for the pop-guns, the teacher stressed the need to read the instructions for the boat carefully. "The instructions to the people that are going to make the boats, make sure you read the instructions carefully for a start."

In addition, the groups assigned the boat activity were provided with the following written instructions (one set per group).

"Hey look, the bubbles do push the boat!"

What you need:

Vinegar

Sodium bicarbonate

A plastic bottle or a jar with a screw top lid (small ones of about 250 millilitres work best)

A straw

Blue tack or a hot glue gun

Tissues

A large container of water

What you do:

Cut a small hole in the bottle and insert the straw

Push it in so the end is three quarters of the way up the side of the bottle

Angle the straw so that any gas that escapes is pushed backwards

Seal the hole with blue tack or hot glue

Pour vinegar into the bottle until it is one third full

Place 2 or 3 teaspoons of bicarbonate of soda in a single layer of tissue, roll it up, and twist the ends so you have made a small parcel

Slide the tissue package into the bottle and quickly screw on the top

Keep a finger over the end of the straw

Give the bottle a quick shake and place this "boat" in the large container of water so that the straw is under the water.

In contrast to the students who were assigned the pop-gun activity, there was no observable excitement demonstrated by the students assigned to the boat activity. Some students expressed negative comments "I'm not reading that! Stupid boats," while others appeared resigned to getting the task out of the way before going on to the pop-gun task. "We'll do the boat first and leave the best 'till last."

Analysis of the written instructions for the pop-gun and boat activities

The written instructions provided for the pop-gun activity were minimal. The required quantities of vinegar and baking soda were written on the whiteboard. Implicit in the written

instructions was the assumption that all students would understand the concept of 1/3 and that it related to 1/3 of a bottle. There was also the assumption that students could differentiate between a tablespoon and a teaspoon and would interpret 1tbsp as one tablespoon. There were no other written instructions provided relating to the order in which the ingredients should be added or the procedures that should be followed. In addition, there was no written warning to confirm the teacher's warning that the bottles were not to be shaken to speed up the reaction.

The written instructions for the boat activity illustrate the quite complex and intricate procedures to be followed if the construction of the boat was to be successful. There was an assumption that students knew what size of container to use, and that bicarbonate of soda was actually baking soda. As the students had not had the benefit of seeing a completed model of a boat, and there were no illustrations on the instruction sheet, the students needed to be able to visualise the finished product in order to understand requirements such as the need to angle the straw correctly so that any escaping gas would be pushed backwards. The instruction to 'keep a finger over the end of the straw' required some further explanation as to why this was necessary, and to give an indication as to when the finger should be removed. In addition to the written instructions, the teacher briefly modelled how to cut a hole in the bottle and to insert a straw in the hole, while simultaneously discussing the need to make a seal around the straw with blue tack.

The clarity of the instructions for making the boats was compromised by the limited time allocated by the teacher. The students were expected to assimilate a substantial amount of information in the space of 1.5 minutes. They were required to listen to the teacher explaining one aspect of the construction process while demonstrating a different aspect. In addition to the brevity of the instructions, the noise level and general restlessness of the class not conducive to students being able to focus on the teacher or to hear what she was saying. Like Jack, some students had already left their desks to get the equipment for their group and missed the teacher's demonstration altogether.

Clarity of instructions.

During the instructional phase, the teacher gave the following specific verbal instructions for conducting the chemical pop-gun activity:

- the bottles should not be shaken once the ingredients had been added;
- the contents should not be tipped out so the vinegar can be reused;
- the corks should not be pushed into the bottles too hard;
- the experiment should be conducted safely;
- the instructions should be read before commencing the activity.

In addition to the verbal instructions, the teacher wrote the required ingredients for conducting the experiment on the white board.

The teacher gave the following specific verbal instructions for the boat activity:

- pierce a hole in the bottle and put a straw in the hole;
- seal around the straw with blue tack;
- wrap baking soda in a tissue and place it in the bottle with some vinegar;
- ensure the straw is under the water;
- boats should be constructed according to the written instructions;
- students should read the instructions carefully before commencing the activity.

As previously discussed, the instructions were interspersed throughout the whole class discussion phase of the lesson rather than being given in sequence or as a discrete set. While giving verbal instructions for making the pop-guns, the teacher was simultaneously questioning the students about the possible reactions they might observe and writing the required materials for making the pop-guns on the board. Interspersing the instructions in this way resulted in a lack of continuity and fragmentation. An additional factor compromising the clarity of the instructions was that of the excited, restless behaviour of many of the students as a consequence of the way the pop-gun activity was promoted. This caused a number of disruptions to the flow of the instructions and discussion due to the need for the teacher to issue a high number of reprimands and requests for students to pay attention.

The clarity of the instructions for the boat activity was compromised by the extremely limited time allocated by the teacher. Other than being instructed to read the instructions before commencing the experiments, no specific verbal instructions were given for undertaking the experiments in accordance with any systematic procedures, rules, or processes that may have been established for conducting group science experiments during previous science lessons.

Clarity of instructions and the effect on student understanding and motivation to carry out the activities

Despite the total length of time spent on giving instructions, at the end of the instructional phase some students were still confused about some aspects of the activities. Although the teacher had assigned one activity to each of the six groups, some students were unsure of which activity their group was expected to undertake first. Some students were under the impression they could choose which experiment to conduct first as demonstrated by Jeff's discussion with Carly, one of the more dominant girls in his group. Their group had been assigned the pop-gun activity first. Jeff appears to have understood the teacher's instructions,

but ended up being persuaded by Carly's argument. As it was raining, they decided they would do the boat activity first, leaving the preferred pop-gun activity for a fine day.

Carly: We'll do the boat first and leave the best part for last.
Jeff: Carly, you don't get to choose. You don't get to choose.
Carly: I think we do.
Jeff: That's what I said. And do the pop-gun on a nicer day.

In summary, the very limited detail provided in the written instructions for the pop-gun activity left students dependent on remembering the relevant verbal instructions that had been interspersed in a fragmented way throughout the previous eighteen minutes. In contrast, students were left largely dependent on following the comprehensive set of written instructions for the boat activity. This indicated an assumption on the part of the teacher that all students were capable of reading and interpreting these quite complex instructions.

The clarity of the instructions given for the two activities may have contributed in part to the extent to which the students were motivated to carry out the activities. The preference to undertake the pop-guns first by most students may have been influenced by the relative simplicity of the instructions as written on the white board. The additional time spent on giving instructions for the pop-guns may have helped to clarify the activity.

It is of interest to speculate whether increasing the clarity of the instructions for the activities would have resulted in the students behaving differently during the next phase of the lesson where the activities were carried out in groups. Due to the extreme excitement of many of the students before carrying out the activities, it is questionable whether they would have paid additional attention to a set of clear, systematically stated instructions. The desire to start the activities, reach the 'explosive' outcome as quickly as possible, and to have as much fun as possible in the process, may have negated any chance of the activities being carried out in a more orderly or 'scientific' manner.

The chemical pop-gun activity is an example of an activity where the novelty and excitement factors may distract students from engaging with the related concepts and from carrying out the activity according to instructions. As stated by Jack "I wanna do the exploding one!"

Effects of the differences in the use of the discussion and instructional phase for each activity

As demonstrated in the above descriptions, the differences in the way the teacher introduced, discussed, and gave instructions for each activity were most evident in two main areas. First, there was a disproportionate amount of time given to one activity at the expense of the other.

Second, the teacher used a humorous, and entertaining approach when introducing one activity and a more serious, functional approach when introducing the other.

The variation in the amount of instructional time given to each activity was significant. The teacher spent a total of 4.5 minutes giving mainly verbal instructions for making the chemical pop-guns. In contrast, she spent only 1.5 minutes giving instructions for making the boats. The additional time spent on the pop-gun activity enabled the teacher to promote it in a positive way. Time was available for the teacher to ask questions and to engage students in making predictions about possible outcomes of the experiment. The teacher asked ten content related questions directly related to the concepts embedded in the chemical pop-gun activity. This gave students a number of opportunities for cognitive engagement with the concepts, and furthered their knowledge of the expected outcome of the activity. The teacher also used this time to write the very brief instructions for making the pop-guns on the whiteboard, confirming for students the simplicity of the activity. In addition, the teacher took time to promote the pop-gun activity positively through the use of humour and personal stories. This had the effect of creating interest in the task and motivating students to want to carry out the experiment.

In contrast, the boat activity was not promoted in such a positive or stimulating manner. By the time the teacher had finished giving instructions for the pop-gun activity, the students had been sitting for approximately 15 minutes and were becoming increasingly restless and eager to carry out the pop-gun experiment. This behaviour may have influenced the teacher's decision to reduce the time spent on giving instructions and discussing the boat activity to a minimal 1.5 minutes. This limited time restricted the teacher to giving only very basic instructions. Student input or discussion was restricted due to the fact that the teacher asked only one concept related question. Students were given very limited information on the expected outcome of the activity. The teacher's final comment, "Hopefully your boat will move along. Hopefully", did little to engender any enthusiasm on the part of the students to undertake the activity.

In contrast to the humour and excitement created during the discussion of the pop-gun activity, the teacher appeared serious as she emphasised the intricate nature of the required construction for the boats. Students were then given a comprehensive set of written instructions for carrying out the activity and were cautioned to read the instructions carefully before commencing construction of their boats. This warning confirmed for the students that the boat activity was the more complex and time consuming of the two.

The brevity of the instructions for the boat activity, and the increasingly restless behaviour of many students while they were being given, raises doubts as to how much relevant

information could have been heard and understood by the groups assigned to the activity. The instructions for the boats were immediately followed by a further discussion of the pop-guns. As a consequence, the instructions for the boat activity were both minimal and overshadowed by those given for the pop-guns.

Effects of the instructional phase on students' activity preference

It is considered that the differences in the way the two activities were introduced, and the excitement generated by one student's retelling how he was almost hit in the eye, contributed significantly to the students' differing perceptions of the activities, and their subsequent preference for carrying out the pop-gun activity first. At the conclusion of the instructional phase many students perceived the pop-gun activity to be fun, exciting, simple to carry out, quick to complete, and therefore the preferred activity. In contrast, not only was there no guarantee that the boats would be successful, it was clear that they would require considerably more effort to construct.

The preference for the pop-gun activity is illustrated by Elle's comment to the group of students next to her. When the teacher had assigned the tasks to the groups Elle turned and stated: "We're doing pop-guns." Elle emphasised the word we're and showed her satisfaction by smiling. Rod, one of the students assigned the boat activity sought reassurance from the teacher that his group would also get an opportunity to carry out the pop-gun activity asking "The people doing boats, will they get to do the chemical pop-guns tomorrow?" The teacher confirmed that everyone would be given the opportunity to do both activities.

Some students were overtly negative about being assigned the less exciting, more demanding boat activity. This was particularly evident in Jack's group. Jack was the only subject who was in a group assigned the boat activity first, and he was clearly disappointed not to be conducting the pop-gun experiment. Before starting the activity, Jack asked the teacher twice if his group could do the pop-guns first. As he was speaking to the teacher, another boy in Jack's group was pulling faces behind the teacher's back. When the teacher declined his request, Jack stated to the other boy: "Don't worry. We'll do the best one last." When it was clear they were expected to do the boats first, one boy in Jack's group glanced briefly at the written instruction sheet for the boats and stated: "Ohhh! I'm not reading it! Stupid boat!"

Another boy in Jack's group stated: "We want to do the pop-guns" to which Jack replied: "Yeah, we want to do the pop-gun. Me and Dexter know how to do it. Me and Dexter...me and Dexter know how to do it." The other boy responded: "Yeah, everyone knows how to do that. Everyone wants to do pop-guns." This last comment demonstrates the student's perception that the pop-gun activity was fun, easy, could be done by everyone, and was therefore the more desirable activity.

The data supports the contention that when multiple activities are planned for a single lesson, the way in which the activities are promoted may have significant effects on student preference and motivation for carrying them out. When the activities are perceived by students to be similar in relation to their general interest and appeal, the potential to be exciting and enjoyable, and in the degree of difficulty or required effort, the effects may be minimal. Conversely, when students perceive one activity to be more exciting and more desirable than the other, the resulting effect on their motivation to engage with and complete the least preferred activity may be significant.

The effects of the negative perceptions that some students had of the boat activity on their motivation to undertake and complete the activity is discussed further in Chapter Six.

3. Classroom discourse

In this section, an analysis of classroom discourse during the introductory and second short instructional phase of Lesson Two is provided. Data is grouped and discussed under sub-headings as for Lesson One.

Opportunities for student participation in the introductory phase of the lesson

There were a number of opportunities for students to participate in whole class teacher-led discussions during the lesson. During the initial 18.25 minute introductory and instructional phase, 13 of the 28 students participated verbally. Their combined responses totalled 22. Of the 22 responses, 16 were made by the same seven students. Two students (Jack and Jed) were selected to respond three times each. Five of the students were selected twice each, and six students were selected to respond once. In addition, one student was selected to draw a graph on the white board to demonstrate the concept of 'optimum point'. In total, students spoke for 4.45 minutes (approximately 25%) of the time. For the other 13.5 minutes, the teacher was the only one talking.

There were seven instances when students raised their hands to ask the teacher a question and were asked to put them down.

Teacher language: Type and level of complexity

It is considered the teacher's language was at a level that could be understood by most students. The exception would be those students who had recently arrived from Asia and had limited understanding of English. One term that may not have been understood by some students was 'benchmark'. Other terms such as 'predict' appeared to be understood by most students.

Frequency of teacher use of selected words

The teacher's language during the introductory and instructional phases of Lesson Two was analysed for the frequency of use of the following words: 'you' (including 'you're', 'you'll', 'you've'), 'I' (including 'me', my, 'I've'), 'we' (including 'we'll', we've', we're'), 'what,' and 'why'.

The teacher used the words 'you,' 'you've,' 'you're,' or 'you'll' a total of 100 times (83 times in the first instructional phase, 17 times in the second instructional phase).

The words 'me', 'my', 'I', or 'I've' were used a total of 46 times (38 times in the first instructional phase, 8 times in the second instructional phase).

The teacher used the words 'we', 'we're', or 'we've' a total of 27 times (26 times in the first instructional phase, once in the second instructional phase).

These rates of teacher use of the words discussed above are comparable to those in Lesson One. The predominance of words containing 'you' are consistent with the teacher's stated philosophy of encouraging this group of students who are considered to be of high ability, to take responsibility for their own learning and behaviour. Examples of the teacher's use of 'you' in Lesson Two include "You don't need to shake it up," "When you're ready, you need to put some baking soda in, and it tells you how much," "You've got to wait for all of the instructions first."

As with Lesson One, the word 'I' was most commonly used as a directive to denote her authority, or to preface a reprimand, for example "I can't hear," "I'm waiting," "I want you to listen."

Consistent with Lesson One, the word 'we' was used at a significantly lower rate than either 'you' or 'I'. 'We' was used to denote inclusiveness, for example "What we're moving into," "There are two things that we're going to have a go at today," "How much baking soda do you think we will need?"

The word 'what' was used a total of 21 times. 'What' was used in the context of discussing procedural matters four times, for example, "What's leaking?" It was used six times as a directive, for example, "What I want you to do." The most frequent use of the word 'what' was in the context of teacher questions to test student understanding of the concepts she had planned to teach, and to get them to think of their findings in relation to their predictions. The teacher used 'what' in these contexts a total of 11 times. Examples include, "What happens to

the reaction?", "What did you change?", "What would a benchmark be?", "What does that mean for the chemical reaction?"

The teacher used the word 'why' on four occasions, twice to preface a content related question and to encourage student predictions, for example, "Why would you have to seal around the straw?" and "Can you tell me why?" 'Why' was used once to explain the reason for an instruction "That's why I've asked you not to," and once in a general discussion with a student about a procedural matter.

The rate of the teacher's use of 'what' and 'why' in the context of asking content related questions is significantly higher in Lesson Two than her use of 'why' and 'who' in Lesson One. This is consistent with the much higher number of content related questions asked in Lesson Two (a total of 13) than in Lesson One (a total of two).

Teacher assumptions about students' existing knowledge and understanding

In contrast to Lesson One, the teacher made few assumptions about the students' prior knowledge of the concepts or activities in Lesson Two. The first assumption was made at times 20-21 as the teacher was introducing the pop-gun activity.

Teacher: So the first one is the chemical pop-guns. Put your hand up if you know how to make them first. I don't think it needs an Einstein to work this one out.

The second major assumption was in relation to student ability to read and interpret the written instructions for the boat activity. With the minimal written instructions provided for the pop-gun activity, there was an assumption that the students would have the prerequisite knowledge to carry out the measuring components of the task accurately.

The most significant assumption was in relation to student interest and motivation to carry out the activities. While the students' interest and motivation to start the pop-gun experiment would have been clearly evident, the teacher would not have realised the extent of the negative attitudes of many students towards being assigned the boat activity, or the resulting effects of their negativity on their subsequent engagement with the task.

Effects of teacher assumptions on student participation

The most significant effect of the teacher's assumptions on students' participation in the introductory and instructional phases of the lesson was the extent to which all students would be motivated to carry out the activities. The major effects were very obvious in the activity phase of the lesson in relation to carrying out the activities in accordance with instructions, adding the correct rations of ingredients, staying in the teacher nominated groups, and

carrying out the assigned activity, particularly in the case of students who were expected to complete the boat activity. These effects are discussed further in Chapter Six.

Teacher questions related to content

The teacher asked a total of 9 questions related to content during the introductory and instructional phases of the lesson. The first question was asked at time 5 and required students to read out statements they had written about chemical formulae in the previous lesson. Thirteen students were selected to respond over the following three minutes.

The other six content related questions included the following:

Time 20 – Put your hand up if you know how to make them (pop-guns).

Time 22: Is there anybody that thinks Jed's left something out?

Time 26: How much baking soda do you think you might need?

Time 27: What would a benchmark be?

Time 42: Why would you have to seal around the straw? What's another reason?

Time 50: Why don't you have to shake the bottle? There's another reason.

Nine students were selected to respond to the six questions. Their combined total interaction time with the teacher was 1.45 minutes.

The other two content related questions were asked during the second brief instructional phase as follows:

Time 100: Put your hand up if you can tell me why when we had a few groups with the chemical pop-guns outside, why it didn't work?

Time 102: Is that the same as what Pat said?

Four students were selected to respond. All four had been selected to respond to the teacher's questions in the first instructional phase also.

Student-initiated questions and statements in relation to content

One student asked a content related question at time 49.

Marsden: Do you have to shake the bottle?

Teacher: No, you don't have to shake the bottle. Why don't you have to shake the bottle? Jed?

Jed: Because the chemical, the carbon dioxide mixes it and makes it into power.

T: Yes. And there's another reason too. Elle?

Elle: Because the baking soda works its way into the vinegar and it can start making the carbon dioxide.

T: Right. Okay. Because it's going to react, you don't need to shake it up. All right? If you shake it up you'll just get a bigger mess and we don't need that!

The teacher's response is an example of the use of effective teacher questioning and responding strategies. The teacher provided a definite response, reinforcing it by restating part of the student's own words. She then asked another student to provide a second reason, thus providing additional opportunities for student participation, and to extend the students' thinking about the reasons for not needing to shake the bottle.

Teacher questions and statements related to procedural matters

The teacher asked a total of nine questions related to procedures for carrying out the activities. Two of the questions were about the groups students had been assigned to. The remainder were requests for students to get equipment or to ensure they had understood the instructions. Often these questions came immediately after a statement or instruction and were stated simply as "All right?" for example: "Make sure you've got your vinegar in here. All right?"

The teacher was clearly concerned about safety issues relating to the pop-gun activity. She made four specific references to the need for students to carry out the activity safely, for example at time 30 she stated: "Now the important thing to remember here is safety." The need to stand well back from the exploding bottle was stated at time 35, and reinforced at time 48 with a warning to students not to race back to the bottle until it had finished foaming. The final request was issued at time 71 when the teacher stated "Please be careful!"

Student questions related to procedural matters

Students asked a total of two questions related to procedures for carrying out the activities. One student asked if they would all get turns to carry out each activity. Another student asked if the pop-guns would make a really loud noise. The lack of student questions may have been due to their extreme excitement and the desire to start the activities as soon as possible. The students assigned the pop-guns appeared confident in their understanding of the activity. The students who were assigned the boats did not have an opportunity to ask questions due to the extremely limited time allocated to providing the instructions and the fact that the boat activity was not introduced until the last seven minutes of the introductory phase.

The teacher declined to respond to students' hand raising behaviour on seven occasions. It is not possible to determine the type of questions the students wanted to ask.

Effect of teacher responses on student understanding

As demonstrated, in response to the students' 22 answers, the teacher gave specific feedback to indicate whether a response was correct or incorrect on four occasions. On the other 18 occasions, the general nature of her responses would have been open to individual interpretation of the students. On three of these occasions the teacher indicated that the partly

correct or incorrect responses were actually correct. These responses could have led to potential confusion of some students' understanding of concepts, or reinforced the misconceptions held by some students.

Teacher language when acknowledging student responses

The language used by the teacher when acknowledging students responses to her questions was consistent with that used in Lesson One. Rather than providing students with definite responses to indicate whether their answers to her questions were correct or not, the teacher often used general terms such as 'okay' and 'thank you.'

The teacher used 'thank you' in response to 15 of the 22 answers given by students. The word 'yes' was used in response to three of the students' answers, once to acknowledge a correct response, once to acknowledge a partly correct response, and once to acknowledge an incorrect response. As demonstrated in the following example, on the occasion when 'yes' was used in response to a correct answer, the teacher also qualified her response by making a statement to a related concept. This helped to expand on and clarify the students' answer by providing a context for other students.

Jed: Scientists try and make everything short.

Teacher: Yes. And that's coming back to the chemical formulae isn't it?

The teacher acknowledged a correct response by stating "Right, okay." 'Right' was also used once to acknowledge an incorrect response. The word 'no' was used once in response to an incorrect answer.

Effects of the introductory phase on student behaviour

Due to the excitement generated by the discussion and positive promotion of the pop-gun activity, a number of students engaged in a range of inappropriate or disruptive behaviours. Some of the more covert behaviours included fidgeting, whispering to peers, or self-talk while the teacher or other students were interacting. Other students engaged in more overt, disruptive behaviours. Rather than raising their hand and waiting to be selected to respond to teacher questions, some students shouted out their responses spontaneously. Other students spoke loudly to their peers, while others made noises and gestures to demonstrate anticipated explosions. A small number of students, including one of the subjects (Jack) did not wait to be dismissed, leaving their desks to start organising their group's resources for the activities.

Teacher language related to management of students

In an attempt to manage the students' excited behaviour and engage them sufficiently to complete giving the activity instructions, the teacher issued a total of 49 reprimands or requests for attention during 87 intervals. During the first 73 fifteen seconds intervals, the

teacher issued 41 reprimands or requests for students to wait, listen, or pay attention. During this 18.25 minutes period, a total of 12 full 15 seconds intervals were spent with the teacher simply waiting for students to settle with no discussion or instructions being given.

During the second short instructional phase, reprimands were given in 8 of the 14 fifteen seconds intervals. In some instances, the teacher issued more than one reprimand in one fifteen seconds interval. This was particularly evident during the last seven minutes of the instructional phase (times 46-73), as the students lost interest in the discussion and were excited and eager to start the pop-gun activity in particular.

Between times 46-73 the teacher made 26 statements related to the management of student behaviour. The resulting effect of this high rate of interruptions on the continuity and flow of instructions is demonstrated in the following example taken from times 64-69.

Time 64
Teacher: Go and sit down please. Would you put that away thanks Rewa. I'll have that.
Time 65
Teacher: Right. Hand up if you can hear me. Could you bring me one of those big soft drink bottles please. Hand up if you can hear me. Hand on your head. Hand down here. Excuse me! Hand on your head.
Time 66
Teacher: And hand on your shoulder. Excuse me! I asked everyone to sit on a chair please so I can see what's missing. Carly, put that down thanks.
Time 67
Teacher: Right Mel, could you go over, There's a small coke bottle over there with some vinegar in it. It's not coke, it's vinegar. And bring it over for your group.
Time 68
Teacher: Put your hand up if you don't have a small bottle please. You've got one in your hand! Listening carefully please. Hand up if you can hear me.
Time 69
Teacher: And hand down. Listen carefully! Put your hand up if you've got one of the big boxes of baking soda.

During the same 1.5 minute period, many of the students were clearly disinterested in the discussion, ignoring the teacher's requests for attention, and choosing instead to engage in conversations with peers, or to organise resources for their experiments. Jack was out of his seat attempting to find the equipment for his group. He engaged in two conversations simultaneously. One involved a dispute with a girl from another group over the number the teacher had assigned to their group. The other conversation was with a boy about the

equipment required for the activity. The following extract demonstrates one example of the parallel conversations being carried out during the same 1.5 minute interval when the teacher was attempting to provide instructions.

Time 64

Jack: Mel asked if they were group six. Yay, we're group six eh?

Boy: No, we're group five.

J: Are we?

B: Yes.

Time 65

J: We're five. Someone else has got ours.

B: Someone got our box.

J: It's not there.

Time 66

B: Jack thought we were group six.

J: It isn't there. It isn't there.

Time 67

J: Mel, Mel!

Time 68

Jack (mimicking teacher): Put your hand up. Put your hand up. Put your hand up.

Time 69

Jack (whispering to other students): A big one's a lot better.

The excitement demonstrated by some students, and the high rate of teacher reprimands issued by the teacher, resulted in prolonging the instructional phase. The disruptions interrupted the flow of the discussion, resulting in further fragmentation of the instructions.

4. Characteristics of individual learners

Summary of subjects' behaviours during the introductory and instructional phases of Lesson Two

The behaviours exhibited by the individual subjects and the extent of their interactions with the teacher and their peers during the instructional phase varied considerably. Table 14 demonstrates the extent of each subject's engagement and interaction with the teacher and peers during a number of specific teacher-led discussions in a whole class context during the 49 minutes science lesson. Such discussions were interspersed at random throughout the full lesson (see Table 13). These interactions include attending behaviour (indicated as Attending

T), and the frequency of utterances to the teacher, (indicated as Talks T). The frequencies of fidgeting, yawning, and self-talk behaviours are also recorded.

Table 14

Subject' behaviours during the 49 minute science lesson

Time in 15 second intervals	Total intervals	Total minutes	Individual Subject behaviours			
			Beth	Jeff	Elle	Jack
1 – 13	13	3.2	Attending T Yawns x2	Attending T Yawns x3 Fidgets x3	Attending T Talks to T x 2	Attending T Talks to T x1 Yawns x1 Fidgets x 1
14 – 73	60	15.0	Attending T	Attending T Yawns x9 Fidgets x5 Talks to peer x4	Attending T Talks to T x1 Talks to peer x4	Attending T Talks to T x5 Talks to peers x24 Content self talk Unrelated self talk Fidgets x3
94-106	13	3.25	Attending T	Attending T x3 Not engaged x4	Attending T Talks T x2 Fidgets x3	Attending T Content self talk
145-158	14	3.5	Attending T	Attending T Fiddles x4	Attending T Talks T x 1 Reading topic book Calls out answer	Attending T Unrelated self talk Content self talk Self corrects
159-166	8	2	Attending T	Attending T Fiddles x4	Attending T	Attending T Talks T x1
176-182	7	1.75	Attending T	Organising resources Writing in topic book	Organising resources	Talking to peers Organising resources
Total	115	28.7				

Table 14 demonstrates the considerable variation in the number of social interactions and utterances made by the subjects during the lesson.

Beth sat passively and was presumed to be watching and listening throughout the entire instructional phase of the lesson. She did not interact with the teacher or her peers during these times. Beth exhibited no fidgeting behaviour and only yawned twice at the end of the first instructional phase of the lesson.

Jeff was watching the teacher and presumed listening throughout the instructional phase of the lesson. He appeared tired, yawning nine times during the first instructional phase. Jeff's yawning was particularly pronounced during the final three minutes when he yawned five times. Jeff looked at his watch twice, and rubbed his eyes and fidgeted on an additional nine occasions during the instructional phase.

Elle demonstrated a high rate of appropriate attending behaviour (presumed listening and watching) during the whole class teacher-led revision and instructional phases of the lesson. She was actively engaged as demonstrated by her high rate of responding behaviour.

Jack was actively engaged throughout the instructional and discussion phases of the lesson. Jack had had previous experience of the chemical pop-gun experiment before school started that day and was keen to share his knowledge of the outcome of the experiment publicly with his peers. Jack clearly enjoyed being the focus of attention when the teacher recalled the potentially dangerous episode in which he had been involved that morning.

Although Jack appeared to be watching and listening during much of the whole class discussion, he often ignored the teacher's requests for students to pay attention. Jack managed to talk to his peers on 22 occasions when he should have been listening. Jack was not singled out for reprimand for his behaviour. As many other students were also talkative, the teacher issued general reprimands to the whole class rather than to individuals.

Summary of hand raising behaviour during whole class discussion and instructional phases

The accepted classroom protocol for responding to questions was for students to raise their hands and wait to be selected to respond. The extent to which individuals participated depended on the number of times they raised their hand and were selected by the teacher, or alternatively, the number of times they succeeded in engaging the teacher or responded to a question by calling out the answer instead of waiting to be selected.

Table 15 provides a summary of the subjects' hand raising behaviour and demonstrates the difference in the number of times individual subjects raised their hands in response to content-related teacher questions or requests for students to demonstrate their attention during the whole class teacher-led discussions.

Table 15

Number of times subjects raised their hands in both whole class and group task contexts during the 49 minute science lesson.

Context	Beth		Jeff		Elle		Jack	
	Content	Unrelated	Content	Unrelated	Content	Unrelated	Content	Unrelated
Whole class	0	3	2	3	10	4	15	3
Group	0	1	3	1	3	3	2	2
Total	0	4	5	4	13	7	17	5

Beth demonstrated a low rate of hand raising behaviour throughout the lesson. Apart from raising her hand once to confirm her group had baking soda, and three times in response to the teacher's request for students to demonstrate they were paying attention, Beth sat passively throughout the whole class and group discussion phases of the lesson.

Jeff raised his hand five times in response to content related teacher questions, and an additional four times in response to teacher requests for students to demonstrate they were paying attention. He was selected to respond once to the question "What do you call it if you've got one substance and you're starting to put a lot of it in, and then suddenly it doesn't want any more of it? It's called doing something to a solution." Jeff gave the incorrect response "Diluting." Jeff's answer was corrected immediately by Elle who out: "Saturating."

Elle was actively engaged throughout the whole class discussions as demonstrated by her high rate of hand raising behaviour. She raised her hand ten times in response to content related questions and an additional seven times to demonstrate that she was paying attention. Elle was successful in engaging the teacher on five out of her ten attempts to respond to content related questions. She was selected by the teacher to respond to four questions and she called out the answer to a fifth question without being reprimanded by the teacher for doing so. Elle's responses included information concerning the ways in which chemical formulae are written (revision from previous session); a description of how baking soda works its way into vinegar to make carbon dioxide; the need to add correct amounts of ingredients when conducting experiments, and an explanation of the way that her group had added more baking soda on their successful second attempt at making the chemical pop-guns.

Jack raised his hand in response to content related teacher questions on 15 occasions during this period. He was successful in engaging the teacher in discussions on two of these

occasions. Jack contributed one of his statements during the revision session stating: "Acids are not only liquids." He was selected to respond to the question about how much baking soda would be needed for the pop-gun experiment stating: "About a teaspoon or so." Although his answer was incorrect the teacher appeared to confirm it by stating "Right" before asking another student for their prediction.

Jack demonstrated an energetic way of responding to the teacher's questions by calling out answers on four occasions. The teacher accepted Jack's call-outs on two occasions, and reprimanded him on the other two. In addition, Jack engaged in self-talk, for example "I knew that," on 14 occasions throughout the lesson. Jack also responded to the teacher's requests for students to predict possible reactions either sharing his predictions with his peers, or by talking to himself.

Effects of teacher response to student hand raising behaviour

The above analysis of the number of times each subject raised their hand and the different ways in which the teacher responded to them, raises some interesting issues related to the possible effects on students when there is a significant variation in the teacher's rate of responding to individuals.

Beth's passivity did not appear to be noticed by the teacher. No attempt was made to engage Beth in the discussions, and no specific questions were directed to her. This is not intended as a criticism of the teacher. It is a reflection of the reality of the management problems faced by the teacher as she attempted to conduct a whole class discussion with a group of 30 students, many of whom were excited and restless in anticipation of conducting the experiments. The number of times Beth responded to teacher requests for students to demonstrate their attention was comparable to the number of responses of two of the other subjects. Beth's failure to comply with every request may be explained by the fact that despite the high rate of such requests, the teacher did not wait for students to comply, and there were no apparent penalties imposed for non-compliance.

Jeff's success rate in being selected to respond to content related questions was 20%. Jeff raised his hand in a whole class context on only two occasions. On the one occasion when he was selected to respond (Time 151), Jeff gave an incorrect answer. The fact that another student (Elle) corrected him by calling out the correct answer may have influenced his decision not to raise his hand again in a whole class context for the remaining 12 minutes of the lesson.

Elle's success rate in engaging the teacher during the whole class discussion and instructional phases of the lesson was higher than that of any other pupil in the class. Elle was selected to

respond to content related questions on five out of the ten occasions that she raised her hand. This 50% success rate is significantly higher than for Jeff and Jack, the two male subjects in the study, at 20% and 13% respectively. There are a number of factors that should be considered when analysing this result. It may be argued that the high number of times Elle raised her hand could increase her chance of being selected by the teacher. This argument is not supported in Jack's case where he was selected only twice out of fifteen attempts. Another possible explanation is that Elle's early success in engaging the teacher (time 9) may have motivated her to respond at a high rate. The fact that Elle's responses were correct may have influenced the teacher's decision to select her, confident in the knowledge that Elle was likely to give a correct response, thus lessening the time needed for whole class discussion within a class of excited, restless students. In addition to Elle's success in engaging the teacher through raising her hand, her one call-out was also acknowledged positively by the teacher.

Jack's rate of hand raising behaviour was very high in comparison to the other students in the class. In spite of raising his hand to respond to content related questions on 15 occasions he was only selected twice to respond. Jack had developed strategies for dealing with this situation. When not selected to respond publicly, Jack often confirmed his own knowledge by verbalising the answers to himself. He also demonstrated his knowledge to his peers by whispering the answers to them. Jack increased his chances of responding publicly through the use of spontaneous call outs to the teacher. It appears that Jack is prepared to risk calling out in the understanding that the teacher is unlikely to be consistent with the way in which she deals with the behaviour and that there is no penalty other than a verbal admonishment. The opportunity to participate and to share his knowledge publicly is reinforcing for Jack and takes precedence over any concern he may feel about receiving a possible reprimand for calling out the answer.

Summary of the effects of the instruction and discussion phase on student interest, and motivation to carry out the activities

The above analysis demonstrates the unique way that each of the four subjects experienced the instruction and discussion phases of the lesson. While all subjects were observed to be watching and listening to the teacher and their peers during this phase, there were significant differences in the subjects' individual responding behaviours and subsequent extent of their public engagement. As a result of being selected to respond during this initial phase of the lesson, Elle and Jack were afforded the opportunity to publicly demonstrate their knowledge and to receive affirmation of the work completed in the previous lesson. This positive reinforcement may have helped the two students to maintain their interest and provide the motivation to engage in the following discussion where the teacher introduced the new concepts for the lesson. Beth and Jeff engaged at a more passive level than either Elle or Jack.

It cannot be assumed however, that the more overt demonstrations of interest and engagement such as hand raising and responding to teacher or peers, gives an accurate measure of a student's interest or engagement. Comments made by Beth and Jeff during the post unit video-cued interviews support the contention that assumptions about student interest and engagement should not be made on the basis of observable behaviour only.

Beth was observed to be passive throughout the instructional and discussion phase of the lesson. It should not be assumed, however, that Beth's passivity was an indication of boredom or disinterest. When interviewed, Beth made a number of positive comments indicating that science was one of her favourite subjects. When asked to respond to a list of words associated with emotion and mood states, Beth selected the words 'happy', 'excited', and 'interested' to describe her feelings about science. Beth qualified her selection by reporting to be in a happy mood at the beginning of science lessons, especially when she knows she will be doing experiments. In response to the word 'interested,' Beth stated "When we do like science things." Beth reported to be excited "When we're going to do another science experiment." In response to what she might be thinking of when the teacher is introducing a new science lesson or activity, Beth responded that she tends to be "thinking what it's going to be like," and that she "gets quite interested when it's (the experiment) actually starting."

Jeff also made a number of comments that indicated his positive perception of science as a subject. Jeff reported to be happy when "I was like doing chemistry." Jeff generally feels that science "Is quite fun and stuff," and that "I'm in a happy mood when it's fun," Jeff is a keen sportsman and in his ranking of subjects, science was placed below sports in terms of enjoyment. Jeff reported that although he enjoys science "When I'm doing science I'm not quite as happy as when playing sports."

Jeff appeared to be passive throughout the instruction and discussion phases of the lesson. In addition he displayed significant amounts of yawning and other behaviour such as rubbing his eyes and fidgeting. In the post unit video-cued interview Jeff confirmed that these actions denote either tiredness or boredom.

Jeff stated "It gets boring like just sitting there listening and when you're doing writing stuff down. When I look at my watch it usually means I'm a little bit bored. Yawning means I'm tired, or sometimes you yawn because you're bored."

When asked what he might be thinking about as the teacher introduces a science lesson or activity, Jeff stated: "I'm thinking about what's going to happen with the chemicals, or what

we're going to do next." It appears that Jeff can maintain his interest while simultaneously displaying outward signs of tiredness or boredom.

Elle maintained a high level of interest and engagement throughout the instruction and discussion phase of the lesson as demonstrated by her rate of hand raising and responding. These observations are consistent with Elle's responses during the video-cued interview. Elle was positive in her comments about science as a subject, selecting the word excited to describe how she feels when the class is about to start a science lesson. At the beginning of a lesson, Elle stated that she would be "thinking about what's going to happen and would be thinking about the correct answer if the teacher has asked a question." Elle stated that "It can sometimes be a bit boring waiting for the teacher and having to listen," but added that she managed to feel "not exactly excited but I am interested most of the time." Elle was one of the few students who reported to have enjoyed the boat activity. "I was happy when we were doing our boats and our boat was going about 2k, about 2k an hour, just about that fast."

When asked how she enjoys class discussions Elle responded: "Sometimes it's quite fun listening to other people's thoughts." It is of interest that Elle experiences an important learning activity, namely listening to others' views, as fun. This might be a factor in increasing the number of cognitive engagements or interactions that Elle has with a concept.

In common with the other three subjects, Jack reported to enjoy science as a subject. "My real interest is science because it's got a lot to do with it, not like just one little thing." Jack stated his clear preference for being outside on a number of occasions during the interviews. He confirmed this by selecting the word happy and qualifying it by stating "I feel happy when I'm outside." When he has to come inside, even to start a preferred subject like science he reports initial feelings of annoyance. "I feel really just annoyed cos I'm really sweaty and all that." These feelings abate as the lesson begins. "I'm getting happier cos we're moving onto something." Jack commented that he gets annoyed with having to sit for a long time. "I get frustrated if I want to get on with something. I want to do it fast and not muck around and all that...When it's really exciting I want to get on with it so you go quick, quick, I want to get on with it. Oh, pop-guns!"

In common with Elle, Jack was positive about the benefits of class discussions. "Discussions are quite helpful so it gets a bit of theirs (ideas) into your mind and you start to think about theirs." When asked about his self talk behaviour Jack explained: "I say it so I've got it into my mind. Saying it just puts it into your mind." Jack added that he started using this method when he was about seven years old. Jack's strategies of calling out and his self talk may be of benefit by increasing the number of cognitive engagements he has with a concept.

Summary

In Lesson Two there was a pronounced focus on introducing the new concepts on which the activities were based and to provide instructions for carrying out the two activities. As demonstrated, there were a number of factors operating in the classroom that reduced the effectiveness of the introductory phase. A major factor was the very excited behaviour demonstrated by many students. The primary cause of their excitement was due to the unauthorised experimentation with the pop-gun equipment by a student before school started that day. The teacher was not in the classroom at the time and another student (Jack) had narrowly missed being hit in the eye with an ejecting cork. The event had quickly circulated around the students who were eager to discuss the event in a whole class context. While the students' disruptions were the result of their genuine excitement, rather than intentional, their continual interjections had the effect of sabotaging the teacher's discussion and instructions. The subsequent reprimands given by the teacher as she attempted to manage the increasingly excited students, compromised the flow and quality of the discussion relating to the scientific concepts.

Rather than discussing the concepts first, and then providing the instructions for each activity in discrete sets, the teacher interspersed the instructions for making the pop-guns throughout the discussion of the concepts. While the concepts discussed in relation to the pop-guns were the same for both activities, it cannot be assumed that the students would be able to generalise them to the different context of the boat activity. The lack of a systematic, cohesive discussion of the concepts appeared to compromise the students' understanding as demonstrated in some of their responses to the teacher's questions.

Similarly, the lack of a systematic delivery of instructions for each activity appeared to compromise their clarity. The students were clearly not interested in the finer details such as the correct ratios of ingredients, they simply wanted to start the activity as soon as possible to achieve the anticipated explosive result. The excitement generated by the activity resulted in management problems for the teacher. Realising that she could no longer contain the students, some of whom had already left their seats, the teacher was forced to compromise the amount of time spent on promoting and giving instructions for the boat activity.

As a result of these factors, it is considered that the instructional phase of Lesson Two was successful in motivating those students assigned the pop-gun activity to carry it out, but not in a systematic way. Conversely, it resulted in negative responses from many of the students assigned the boat activity. The extent to which the introductory phase was successful in promoting a clear understanding of the concepts planned to be taught by the teacher, and the

extent to which the students complied with the instructions for carrying out the two activities is discussed in Chapter Six.

In the next chapter I present the qualitative and quantitative analyses of the activity phases of the lessons. This includes an analysis of the open and closed questions written by the four subjects in Lesson One, and an analysis of the subjects' concept learning in Lesson Two.

CHAPTER 6

ANALYSIS OF THE ACTIVITY PHASES OF SELECTED LESSONS

The purpose of this chapter is to present the analyses of data related to the activity phases of the two selected lessons. Nuthall's previous analyses (1999) of typical lessons in science and social studies in Year 5 and Year 6 classrooms demonstrated that most of the activities that made up the social studies and science units (excluding whole class discussions) consisted of the following four distinct but frequently overlapping task components.

- Instructions
- Carrying out the activity
- Writing or presenting a report
- Discussing the results

The focus in this chapter is on the components related to carrying out the activity, writing or presenting a report, and discussion of results in each lesson.

In addition to identifying the four components of a typical activity in social studies or science, Nuthall (2000) also identified the following four different contexts or contextual systems in which students are simultaneously involved as they engage in classroom activities.

- The instruction-evaluation system
- The social interaction system
- The student's own skill and knowledge system
- The physical resource system

The chapter commences with a general discussion of the purposes of activity phases of lessons. The followed by a brief description of the four components of a typical lesson in social studies or science, and of each of the above four systems. A discussion of their significance in relation to student participation in activities is included.

Analyses of the individual students' experience and the teacher's management of the activity phases will be presented for each selected lesson. Data from Lesson One (the Aztecs question writing activity) will be presented first, followed by data from Lesson Two (chemical pop-guns and boats activity).

For each lesson, the analyses of the students' experience of each activity phase will focus on significant behaviours exhibited by each subject and on the work they produced. The limitations inherent in any attempt to isolate a particular moment in time, or to identify a

specific experience a student may have had that influenced their learning of a particular concept are acknowledged. Every attempt has been made to minimise such limitations by using an extensive range of data when analysing each selected student's understanding of the concepts selected by the teacher for inclusion in the selected lessons. This includes:

- subjects' written responses in the pre and post tests;
- subjects' oral responses in a series of post-unit individual interviews;
- subjects' written questions from lesson one and written reports from lesson two;
- transcripts from each lesson;
- observers' notes from each lesson.

Following the analyses of the subjects' work and their concept knowledge, those factors that are considered to have contributed to the subjects' understanding and experience of the lessons will be identified and discussed.

In order to demonstrate the significance of the relationship between the instructional and activity phases of the lesson, the analyses of the teacher management of the activity phases will focus on relevant key themes discussed in Chapter Five. This will include the teacher's monitoring of student compliance with activity instructions, the use of teacher questioning with individual students during whole class discussions phases, management of student behaviour, and the management of resources.

Purposes of the activity phases of lessons

Classroom activities are designed for a variety of purposes. According to the teachers who participated in the Project on Learning, classroom activities are used primarily for students to consolidate and demonstrate their knowledge of the concepts the teachers have selected for inclusion in the lesson or unit.

The teachers reported that they designed activities to enrich their teaching programmes by providing students with opportunities to practice and apply new knowledge, skills, and understandings in authentic contexts. There was consensus that activities that incorporated experimental or hands-on components are particularly valuable in enabling students to be active participants in the learning process. Activities that take into account and incorporate student interest are considered to be effective in motivating students to engage with and complete an activity.

The teachers agreed that when managed effectively, group activities have the potential to provide opportunities for peer assisted and co-operative learning. Effective group activities

were considered to be beneficial in fostering inter-subjectivity and positive social interactions between students.

Description of the four components of a typical activity in science or social studies

Nuthall (2000) provides the following description of the four components of a typical lesson in science or social studies at Year 5 and 6 levels.

1. Instructions

The teacher provides a set of instructions about what the students are expected to do. These can be spoken by the teacher, discussed with the students, printed on a worksheet, or some combination of these.

2. Carrying out the activity

The students engage in an activity on the basis of their understanding of instructions, their knowledge of what is usually expected in such activities, and their awareness of the consequences of following or not following the instructions and conforming to the implied expectations. In addition, their behaviour is constrained by the availability and usefulness of the resources and their ability to negotiate and manage the social context in which the activity has to be carried out.

3. Preparing a report

Almost always teachers require students to record or report on the outcomes of the activity. Whatever the activity, it is rare for students not to be required to show or record something that is evidence of what they did. Since it is this aspect of the activity that is most likely to be evaluated, it exerts a controlling influence on the way the activity is carried out. Often it is the only aspect of the activity the teacher sees and is the only evidence the teacher has that the activity has been appropriately carried out.

4. Discussing the results

During, or at the end of an activity, the teacher usually discusses the outcomes with the students. These discussions relate to the components of the activity, the activity as a whole, or the outcomes of the activity. The purpose of these discussions is usually to provide the students with an account of what the activity and its outcomes are intended to mean or achieve. It is the occasion when the teacher relates aspects of carrying out the activity to the intended academic purposes and processes. Connections are made to previous activities, to previous knowledge, and to the implications implicit in the outcomes. Even if the students had no idea why they were doing the activity, had interpreted its purposes quite differently from the teacher, had not completed the activity, or obtained the wrong outcomes, this

discussion serves to tell the students what they should have done, how they should have understood it, and what they should have concluded (Nuthall, 2000).

Nuthall found the first two to be essential components of an activity. The last two were typical but not essential and depended on the pedagogical purpose of the activity. The first two always occurred in that order, although they usually overlapped with each other.

While it is relatively straightforward to identify a number of common purposes of classroom activities, the way they are managed by teachers, and the way students engage in classroom activities is extremely complex. According to Nuthall (2000) it may appear on the surface that the way students engage in classroom activities is a function of the teacher's instructions (the task design) and management of student behaviour. Nuthall proposes however, that students are simultaneously involved in four different contexts or contextual systems.

Description of the four contextual systems in which students are simultaneously involved when carrying out classroom activities

1. The instruction - evaluation system

The instruction – evaluation system is described by Nuthall (2000) as:

> "...the system that is set up by the teacher's instructions and expectations about how students should follow instructions. This system is the public system of classroom activities that the teacher designs, organises and manages both directly and in face-to-face interaction with the students, and indirectly through group tasks (p.16).

2. The social interaction system

Nuthall (2000) defines the social interaction system as "...the semi-private system of peer interactions and relationships within the peer culture that is partly visible but largely invisible to the teacher" (p. 16). These social relations are held together by the peer culture with its norms that influence the way students regard each other. When doing things with others, differences in individuals' understanding, goals, interests, and how to carry out activities must be taken into account. As a result, students have to balance the social interactions required to carry out classroom activities with the maintenance of their social life and status within and outside of the classroom.

The social relationships that exist within classrooms are complex and changing. The impact of the diverse personalities, values, cultures, beliefs, developmental levels, prior knowledge and experience of thirty or more individual students, plus the teacher's set of beliefs, experiences, skills and knowledge, will determine the unique culture of the classroom. It is within this culture that students must manage the realities of the social and academic

challenges with which they are confronted throughout the school day. According to Nuthall (2000):

> Classroom activities take place within an established and on-going system of social relations between students. This system is made up of informal patterns of roles, status, friendship groupings and changing personal relationships that constitute the social life of the students (p. 17).

The social interaction system is held together by the peer culture with the fashions and norms that structure the way students see and are seen by each other. Doing things with others, even doing things in the presence of others must be taken into account. Other students have different understandings of the nature of classroom requirements, a different sense of how to carry out a classroom activity, different goals and interests. Students must balance or integrate the social interactions needed to carry out a classroom activity with the maintenance of their on-going social life and status inside and outside the classroom.

As the social interaction system is only partly visible to the teacher, the extent to which the teacher can exert control over the system is limited to what can be seen or to what is reported by students to be happening. The more overt behaviours and relationships between students are visible and may therefore be managed by the teacher, and to some extent by the students themselves. It is the more covert behaviours and the semi-private system of peer interactions and relationships that may operate largely undetected by the teacher. These relationships form the set of common social rules and practices of the students. Although such rules are often unstated, they can be powerful influences in shaping the behaviour of students and in determining the different ways in which an individual may experience the social and academic life of the classroom.

Within the classroom context, social interactions can be broadly classified into two categories. The first category includes opportunities for students to interact socially at the request of the teacher or with teacher approval. Most often observed to be content-related, this category includes 'legitimate' or 'teacher sanctioned' opportunities for students to interact with the teacher or their peers. Such opportunities are often planned and incorporated into the lesson intentionally by the teacher.

The second category includes those social interactions that occur either spontaneously, or as a result of students deliberately planning opportunities for additional social interactions with their peers. Spontaneous interactions may include the calling out of responses to content-related teacher questions. In general, however, the interactions that occur in this second category are more likely to be unrelated to the assigned task or activity in which students are

involved at the time. These are the occasions when students discuss a wide range of social issues or discuss topics of personal or group interest or significance.

3. The student's own skill and knowledge system

The student's own skill and knowledge is the third system identified by Nuthall (2000) and is defined as "the private or internal systems of the student's cognitive and emotional processes" (p. 16). The extent to which a student is able to successfully undertake and manage classroom activities is dependent on several factors relating to these cognitive and emotional processes. According to Nuthall:

> A student brings to an activity a range of knowledge, skills, expectations, beliefs, attitudes and feelings about the classroom, learning, and the curriculum content of the activity. During the course of the activity, the nature of the student's involvement in the activity is both determined by, and changes, this system of background knowledge, skills expectations, beliefs, and attitudes and feelings. As the activity evolves, so does this internal cognitive and emotional system (p. 46).

Cognitive processing of instructions and concepts, and the ability to participate in whole class discussions may be determined in part by the student's oral and written language development, and their reading ability. Prior knowledge and experience of the concepts and activities will significantly influence the extent to which the learner may understand and participate. The extent to which the student has developed independent work and research skills will also determine their progress.

The emotional processes determine the student's sense of self and perceptions of their own and others' ability. Emotional processes may be influenced by the following personal characteristics: confidence; motivation; mood; degree of interest or boredom; concentration span; assertiveness; the willingness to take risks, and the extent to which a student may have experienced success or failure.

Layered on top of the cognitive and emotional processes are the many other socio-cultural factors that interact continuously to shape the student's experience of a classroom activity. More importantly, these factors can determine the extent to which a student will meet the intended learning outcomes on which the teacher has based the activity. Teacher and peer expectations, the student's social status within the class, and factors such as age, physical size and gender can all influence the extent to which a student may be able or permitted to participate in the progress through a classroom activity. Nuthall (2000) uses the analogy of a personal journey to describe students' progress through a classroom activity.

> Completing an activity requires a student to apply his/her knowledge and skills to the available resources in ways that fit both the teacher's and peers' expectations of activity. Each classroom activity is a personal journey starting with the student's prior curriculum knowledge, beliefs, and skills, progressing through each active encounter with the curriculum content, and ending with those changes in

> knowledge and belief that these encounters have created. It is usually only as the activity progresses that students find out exactly what knowledge or skill is required. Some parts of the activity will be difficult, other parts easy. Depending on their interest and past experiences with related content, students will often try to find ways to avoid difficulty and stay within a zone of comfort by re-interpreting the activity and re-negotiating responsibility for carrying out the requirements of the activity (p. 67).

Nuthall describes these first three systems as socio-cultural. Each of these systems has its own rules, procedures, and outcomes. While these socio-cultural systems interact with each other, they are structured differently, involve different processes, and affect the learning process in different ways.

4. The physical resource system

The physical resource system is the fourth system identified by Nuthall (2000) and is described as the system that provides the physical context for any classroom activity. "When the activity involves interaction with resources or equipment (as in a science experiment) the sequence of events that make up the activity depend on how well the students manage the equipment or resources" (p. 18). Events also have their consequences, and mistakes, accidents, or misunderstandings that occur in the early part of an activity changes the way the activity can be completed.

There are several factors that may influence the ways in which students manage resources. The more obvious factors are those relating to organisational considerations such as the availability of adequate resources, the physical proximity of students to resources, and established procedures for equitable access by all students. There are also those factors that interact with the three socio-cultural systems (instruction-evaluation system, social interaction system, student's own skill and knowledge system) that can determine a student's use of the physical resource context.

When the verbal or written instructions provided for the use of resources are unclear or lacking in systematic procedural guidelines, there is the risk that instructions may be misinterpreted or that student use of resources may be haphazard, dangerous, or generally contrary to that intended by the teacher. The risk of misuse of resources is increased when commercially produced resources that are not closely matched to the diagnostically assessed needs of the students are not taken into account fully.

When those factors that determine the social interaction system are not taken into account, there may be inequitable access to resources. Domination of resources by assertive individuals may result in the relegation of less assertive students to the role of passive

observer rather than active participant. When the organisation of students into groups is not carefully considered, the chance that the group will function in a cohesive and cooperative manner may be compromised. Students who lack the social skills, status, or confidence required to successfully use the teacher or peers as resources may be disadvantaged.

The student's own skill and knowledge system may determine the extent to which they are able to access resources. Students require the prerequisite language and reading skills required to interpret oral and written instructions for their use. Prior knowledge of the use of the resources and their management may influence the effectiveness with which they can be used. Resource issues are considered to be particularly significant in science activities which involve students in the structured experiencing of the physical world. Nuthall argues that "A full analysis of the ways in which students participate in, and learn from, classroom activities requires this system to be taken into account. Our experience of the physical world is as much part of the way we think as the social world" (p. 42).

The focus in this section of the analysis of the activity phase of Lesson One, is on the four students Rewa, Libby, Rod and Ned. The analysis includes the individual student's experience of the activity phase, including their observed behaviours, engagement with the question writing task, and their interactions with the teacher and their peers. The questions written by each student are analysed for content and type (open or closed).

The analysis of the four students' experience of the activity phase is followed by an analysis of the teacher's management of the session, in particular accessibility to individual students, teacher – student interactions and the use of questioning. During the activity phase of Lesson One the students were required to write a mix of open and closed questions on a selected aspect of Aztec life. The questions would form the basis of the independent research and project work to be undertaken over the following three weeks. A fuller description of the question writing task is provided in Chapter 4 (pp. 156-157).

In conclusion, even the most competent, experienced teacher has limited influence or control over the way these four systems operate in the classroom. In some cases the teacher may be unaware of their existence in the busy classroom environment. Nuthall proposes that only one of these four systems, the instruction-evaluation system, is under the teacher's control. Evidence from the Project on Learning suggests that the lived reality of the classroom experience for teachers and individual students as they manage and negotiate their way through activities is often far more complex than it may appear on the surface. Evidence for this view is presented in the following analyses of the activity phases of the selected lessons.

ANALYSIS OF THE ACTIVITY PHASE OF LESSON ONE

The activity phase of Lesson One was comprised of 91 fifteen second intervals (22.75 minutes). The remaining 5.25 minutes of the lesson were used by the teacher to select individual students to read out examples of their research questions, to collect their topic books to check the questions prior to the next session, and to briefly outline the following sessions when students would be required to conduct their own research into their selected topic. The structure of the 27 minute activity and discussion phase is demonstrated in Table 16.

Table 16

Structure of the 27 minute activity and discussion phase of Lesson One

Time	15 Second Intervals	Minutes	Event
105-195	91	22.75	Individual question writing
196-207	12	3.0	Whole class discussion
208-212	5	1.25	Collecting topic books, discussion of the following week's sessions
Total	108	27 minutes	

Individual subjects' experience of the activity phase of Lesson One

The following section includes the analyses of the individual subjects' experience of the activity phase of Lesson One. Table 17 provides a summary of each subject's engagement and other behaviours during the 22.75 minute individual question writing activity. The totals represent the number of 15 second intervals each subject was observed to engage in the specified behaviour. The subjects may have engaged in more than one observed behaviour in a single interval.

Table 17

Summary of student engagement and observed behaviours in a 22.75 minute individual question writing task.

Behaviour Time in 15 Second intervals	Rewa	Libby	Rod	Ned
Engaged with task (writing, Reading own work)	36	28	28	16
Talking to teacher/trainee	7	1	11	4
Talking to peers (content related)	3	49	5	10
Talking to peers (non-content related)	7	11	11	15
Engaging in off-task behaviours (gazing around room, watching/listening to others)	45	11	23	26
Organising resources	4	6	2	0
Reading topic books	8	0	0	0
Hand raised waiting teacher	0	0	6	5
Talking of self	5	15	3	3

Rewa's experience of the activity phase

As demonstrated in Table 17, the significant aspect of Rewa's behaviour during the activity phase was her off-task behaviour. Rewa spent 45 fifteen second intervals (11.25 minutes of the 22.75 minutes allocated) gazing around the classroom, watching and listening to other students interactions with the teacher and teacher trainee.

There are two main reasons for this behaviour. First, much of the time spent by Rewa listening to others was due to the fact that both the teacher and trainee spent significant periods of time talking to students in close proximity to Rewa's desk. Second, and more importantly, Rewa clearly did not understand the requirements of the activity, or the difference between open and closed questions. This is evidenced by Rewa's question to the trainee at time 107, only 45 seconds after the students had been dismissed to start writing their questions.

Rewa: What's an open question?

Trainee: It can be like, well closed is what's your name?

R: Rewa.

Tr: That's a fact isn't it?

Rewa nods (non-verbal communication - NVC)

Tr: It can't be a different answer because that's what your name is. Your name's not...

R: Joanna or something (laughs).

Tr: Yeah it is – that's what it is.

Rewa nods (NVC)

Tr:	Okay, that's a fact and that won't change. Open could be, do you like the name Rewa?
R:	Not really.
Tr:	Okay, well that's because that's your opinion and...
R:	It can be changed.
Tr:	Yeah.
R:	Nods (NVC)
Tr:	Or open could be – where's Mexico? That's closed or that's because it's a fact. But open could be what do you think Mexico's like? You know like, you know?
R:	Nods (NVC).

The above extract demonstrates the trainee's attempt to clarify the difference between open and closed questions by using a range of examples, including personalising them with Rewa's name. It is significant to note Rewa's limited verbal responses during the interaction. Rewa's high rate of non-verbal communication, in particular nodding her head, is consistent with her self reports in interviews that she will only answer questions if she thinks she knows the answer. It is of interest to note the following comments made by the transcriber at the beginning of the lesson transcript.

> Note: Difficult to convey in transcription but Rewa often seems uncomfortable when teacher or student teacher make a point of coming to talk to her. Often doesn't respond at all (looks away) or responds non-verbally only (shakes or nods head). Get the impression she'd prefer to be left alone.

While the trainee may have believed Rewa's nodding was an affirmation of her understanding, her response did not reveal the level of Rewa's understanding. Rewa continued to gaze and listen to interactions around her for another three full minutes before she finally started to write for the first time, approximately 4.5 minutes after the commencement of the activity phase.

As demonstrated in Table 18 Rewa's behaviour followed a distinct pattern of short periods of writing lasting between 45 seconds to a maximum of two minutes, interspersed with periods of gazing around and listening to others.

Table 18

Pattern of behaviour demonstrated by Rewa during the 27 minute activity and whole class discussion phase of Lesson One.

Time	Intervals	Minutes	Event
104-106	3	.75	Gazing, watching others
107-110	4	1.0	Interaction with trainee
111-121	11	3.25	Gazing, watching others
122-126	5	1.25	Writing and filling out mood slip
127-131	5	1.25	Listening to others
132-133	2	.5	Interaction with trainee
134-136	3	.75	Writing
137-141	5	1.25	Gazing, listening to others
142-146	5	1.25	Writing
147-150	4	1.0	Gazing, watching others
151	1	.25	Writing
152-153	2	.5	Gazing, watching others
154-156	3	.75	Interaction with teachers
157-158	2	.5	Writing teacher's question
158-162	5	1.25	Gazing, watching others
163-164	2	.5	Copying work onto new page
165-169	5	1.25	Gazing, watching others
170	1	.25	Writing
171-174	4	1.0	Interaction with teacher
175	1	.25	Gazing
176-179	4	1.0	Writing
180-181	2	.5	Gazing, watching others
182-188	7	1.75	Moves to resource table, flicks through book, engages in non-content related conversation with peer
189-195	7	1.75	At desk reading book
196-198	3	.75	Copying from book cover
199-211	13	3.25	Copying questions from loose paper into topic booklet

Rewa's interactions with her peers were extremely limited. She spent 30 seconds discussing a movie while flicking through books at the resource table. A significant feature of Rewa's experience of the activity phase is the number of interactions initiated with her by both the teacher and trainee. It is obvious they had noticed Rewa's periods of inactivity and engaged with her to encourage and assist her with the activity. These interactions are considered to be significant as the teacher and trainee provided Rewa with three of the seven questions she wrote. In the following interactions Rewa appears to have mastered the art of non-verbal communication as a way of getting the teacher to provide her with the information she needs to complete an activity.

Times 132-133

Trainee: Now what are you doing? Markets.

Rewa: (NVC – nods)

Tr: And what about markets do you want to find out about?

R: Um. (NVC – shrugs)

Tr: Market. As in what was at the market? In the markets? Keep brainstorming on your own.

Times 154-156

Teacher: Right Rewa, how are you going?

Rewa: Okay.

T: Did you have some other questions written on this sheet?

Rewa picks up map sheet and shows the teacher.

T: Oh you changed your topic too? Okay. What's another question you could ask? Do you know where the markets were?

R: (NVC shakes head)

T: Okay, so is that a reasonable question you could ask?

R: (NVC – nods)

T: Yes.

Times 171-174

Teacher: How are we going now?

Rewa: Yep

T: Yep, Ah-ha, good. Do you think they might have had shops at the market?

R: (NVC – shrugs)

T: Don't know? What's another thing you could find out? You've got what type of shops but do you know what they sold?

R: (NVC – shakes head)

Erin: They didn't sell did they? They traded them.

T: Do we know they didn't sell things? So now you've got some other things. You've just told me you know something that they traded things so you could find out what sort of goods did they trade with? What sort of things did they sell? Did they have shops? You've just got in there lots of things.

The above extracts demonstrate Rewa's use of the teacher and trainee to provide her with ideas. With access to her peers denied, and with no prior knowledge of the topic, the trainee's suggestion that Rewa brainstorm on her own was of no assistance. Through her use of non-verbal communication and by waiting for the teacher and trainee to respond, Rewa was able to elicit the information required to write her questions. This may suggest that in the past, Rewa has learned that responding in this way will result in the teacher ultimately answering her own questions. As a result, Rewa does not have to risk giving an incorrect answer or publicly demonstrate her lack of knowledge.

As demonstrated in Table 18, Rewa was engaged in writing and reading her own work for a total of 36 fifteen second intervals (9 minutes). For a busy teacher circulating around the

classroom of 28 students, it would be easy to assume that Rewa was engaged in writing new material. An in-depth analysis of the 9 minutes Rewa spent writing shows that for 4.5 minutes Rewa was engaged in writing the questions suggested by the teacher and trainee. Rewa spent the other 4.5 minutes copying her questions from a loose piece of paper into her topic book. This was necessary as Rewa had not complied with the teacher's instructions for students to write the questions straight into their topic books. In addition, instead of attending to the whole class discussion phase during the last 4.25 minutes, Rewa spent 3.5 minutes of this time copying information from a topic related resource book.

Analysis of work completed by Rewa during the activity phase

Rewa wrote the following information during the activity phase of lesson one.

Topic = market

Key words = Markets, Money, Size

Closed Questions = How, When, Where

- How big was the biggest market?
- Where were the markets?

Open Questions = Why, Who, What?

- What did they trade?
- What type of food did they trade?
- What was the Aztecs favourite drink?
- What type of fruit or vegs did they trade?
- What did the Aztecs wear?

Rewa wrote the two questions she had classified as closed questions and the first two questions under open questions during the allocated 22.75 minutes. Ignoring the teacher's instructions for students to write their own questions before consulting library books or other resources, Rewa spent the last four minutes of the allocated time looking through the topic related library books displayed at the front of the classroom. Rewa found a suitable book that provided her with the basis for her last three questions. These questions were then written by her during the final 4.5 minutes whole class discussion phase of the lesson. Ignoring the discussion, Rewa read through the text then copied the information, adapting it to question format. It is of interest to note that the answers Rewa wrote in subsequent sessions were copied directly from this text, confirming that she had contravened the teacher's instructions by reading the text, compiling her questions from it, then simply copying the relevant information directly from the text.

Of the seven questions written by Rewa, the only one considered to be self-generated is "How big was the biggest market?" The teacher and trainee provided Rewa with another three questions. Rewa then simply adapted the text from a book to make up her other three questions. Rewa's final question "What did the Aztecs wear?" is not directly related to her topic. It is apparent that Rewa had started to read the next section in the library book and included the question either out of personal interest or to increase her number of questions.

An analysis of Rewa's questions demonstrates her continued misunderstanding of the difference between open and closed questions. All seven of her questions are closed questions. Rewa's misunderstanding is partly explained by her interview response to the difference between open and closed questions as discussed previously. Rewa stated that closed questions have only one answer, whereas open questions can have two. Her confusion may have been the result of Rewa thinking that because she was able to list more than one thing in response to her questions, they then qualified as open questions.

This analysis of Rewa's experience raises a number of issues for consideration. A fundamental problem for Rewa at the beginning of the lesson was that she had not nominated an aspect to research, nor had she written any key words as instructed during the previous session. As a result, she had nothing prepared that she could relate the teacher's instructions to. Rewa was clearly unsure of the difference between open and closed questions that prevented her from starting the task immediately. Once she had selected an aspect to research, her lack of prior knowledge prevented her from designing questions of her own. She was therefore dependent on the input of the teachers. With the exception of the question she initiated with the trainee, Rewa waited for the teacher and trainee to initiate conversation with her.

Rewa's access to her peers as a resource was severely restricted due to the significant period of time (approximately 13 minutes out of the 22.75 minutes available) that the teacher and trainee spent talking to students in her immediate vicinity. The conversations held with other students served as a distracter for Rewa. The physical presence of the teacher and trainee also prevented Rewa from talking to her peers, without risking censure for collaborating during what had been specified as an independent task.

In summary, Rewa had little motivation and limited opportunities to engage with the task other than on a superficial level. Rewa essentially ended up writing questions that were mostly generated by the teachers, rather than out of personal interest. Rewa did not have to think deeply about the topic – the thinking was done for her. Rewa did not evaluate her own questions against those written by others during the whole class discussion of selected

questions. Rewa took advantage of this time to pursue her own goals by copying information from a book on Aztec markets. It is unlikely that she would have heard the teacher's next set of instructions. Rewa did not appear to be well prepared or motivated to carry out her independent research in subsequent sessions.

It is of interest to note that Rewa did eventually change her topic from markets to the way in which the Aztecs told the time. Although the topic was not one of the six nominated by the teacher, Rewa made the change after talking to her friend and seeking the teacher's approval for them to work on the same aspect. In spite of the teacher's initial instructions for students to work individually over the next week, Rewa and her friend worked together on a poster presentation for the majority of the time. Rewa's input was minimal and mostly involved her drawing a coloured border around the limited information written by her friend.

Libby's experience of the activity phase

Libby's experience of the question writing phase of the lesson is in direct contrast to Rewa's. Although Libby had demonstrated a high rate of fiddling behaviour during the instructional phase, it is clear that she thought she understood the difference between open and closed questions and was unconcerned with much of the supplementary information included by the teacher.

Libby's understanding of the task requirements is confirmed by her approach to the task. She had selected her topic and written the relevant key words during the previous session and was well prepared to start the task. Libby's confidence in her ability to write the required type of questions enabled her to start the task without the need to clarify her understanding with the teacher. As will be demonstrated in a later analysis of Libby's questions (see p. 245), although Libby was unable to differentiate between closed and open questions, her belief in her own ability enabled Libby to undertake the task with confidence.

Of particular interest is the amount of time Libby spent collaborating with her peers during the activity phase. As demonstrated in Table 17, Libby spent 12 minutes of the 22.75 minutes working collaboratively with her peers. Although this contravened the teacher's instructions, Libby was able to do this without risking censure from the teacher. The location of her desk in relation to the area of the classroom where the teacher spent the majority of her time assisting other pupils enabled Libby to see where the teacher was at all times. As Libby was also sitting with her close friends, she had ready access to those peers with whom she preferred to work.

Libby spent the first one-minute of the session organising her resources for the activity. She was particularly interested in borrowing her friend's felt pens to decorate her work as she proceeded. Libby spent the next 6.25 minutes writing key words associated with her selected topic 'temples'. After writing each key word Libby carefully drew a coloured border around the word. While writing her key words Libby was continually engaged in conversations with her peers, alternatively asking or answering questions. As a result, Libby and her peers used each other as a resource, only accessing the teacher to ask how to spell an unknown word as evidenced in the following extracts of conversation taken from times 112-116.

Libby:	I know, I put an eagle happily eating a snake.
Randal:	Does anyone know a keyword for temples?
L:	Temples. Um, sacrificing. Aztecs.
Jody:	Sacrificing.
L:	I told you that. Okay, sacrificing.
J:	How do you spell it?
L:	Don't know.
L:	(calling out to teacher) Miss H, Miss H, Miss H. How do you spell sacrificing?
Teacher:	I'll write it on the board for you.

At time 133 Libby decided she had written sufficient keywords. She counted them to herself before announcing to her friends "Oh, five is enough. Getting onto my questions." Unlike other students who were unsure of how many questions to write, Libby gained approval from her friends that she had enough keywords, giving her the confidence to proceed to the next stage of the activity without having to seek further confirmation from the teacher.

The following extract taken from times 133-138 demonstrates how Libby collaborated with her friends Jody and Mia when starting to write her questions.

Jody:	Don't you have any questions?
Libby:	No, that's why I've got to get on.
J:	I have some.
L:	Same, so do I but why were they built?
J:	Why were they?
L:	She asked why they were built. To worship their gods, to sacrifice people and all sorts of answers.
Mia:	We don't know.
L:	Okay, another one?
J:	I've got, when were they built? We don't know they were built.

L:	Yeah.
J:	Who used them? We don't know that.

Working collaboratively in this way was of obvious benefit to Libby in terms of her confidence to continue with the activity. After a brief exchange over pens, Libby was clearly starting to think about writing closed questions. The following extract demonstrates how Libby sought confirmation of her question from Mia and how Mia encouraged her to articulate her ideas.

Time 141

Libby:	(to herself) Closed questions.
L:	(to Mia) What about – I don't think they were but...
M:	Have to go.
L:	Were children sacrificed?
Mia:	I don't think so.
L:	We'll see.

As Mia did not dismiss Libby's question, Libby subsequently added it to her list. Immediately following this conversation, an observer handed out a mood slip to the students. The following extract gives an indication of how Libby reported her mood at the time.

Time 144

Libby:	Are you excited?
Lorraine:	No.
L:	Oh Mia's put she's excited.
Mia:	Hey, don't look! What are you putting?
L:	Interested.
Mia:	Yeah, I am.
L:	Tired and bored (laughs). Bored and interested.
Lorraine:	You can't be happy and sad because...
L:	Yeah, I suppose you can but. Yeah, you could have been happy but when you saw the sheet you could have been sad (laughs).

While it is not possible to determine exactly how the students were feeling at the time, the fact that the conversation was animated and interspersed with laughter suggests that they were experiencing the more positive emotions, such as interested, excited and happy.

Another benefit of working collaboratively was the way in which Libby and her friends corrected one another's errors. At time 156 Libby read out the following question. "Were people watch the sacrifices?" Jody responded: "Did people watch the sacrifices?" Jody placed the emphasis on 'did' causing Libby to respond "Yeah." Libby then erased 'were' and replaced it with 'did.'

The support of the group was mutual. Libby was prepared to stop to assist her peers at their request. As demonstrated in the following exchange between Libby and Randal, often the exchanges were of mutual benefit in terms of the content. In this example, although Randal started by asking Libby for information, the resulting conversation was of benefit to Libby in providing her with an opportunity to compare her keywords with Randal's.

Times 165-166

Randal:	I need some more keywords.
Libby:	Keywords? These aren't keywords. Um, temples.
R:	Got that.
L:	Sacrifices.
R:	Got that.
L:	Gods.
R:	Got that.
L:	Priests?
R:	Got that.
L:	(talking of self) Gods, priests.
L:	(talking to Randal) Aztecs?
R:	Got that.
L:	Sorry, that's all I've got.

Libby's group also used each other in an attempt to differentiate between open and closed questions. In the following extract it is interesting to note the way in which the students used the same indefinite response of "It depends, it just depends" that was given by the teacher during the instructional phase.

Times 167 – 170

Libby:	When were they built? Um, how long did it take them to build it?
Mia:	Yes.
Randal:	Open question. How.
L:	How long did it take them to build temples?
R.	Yeah. It's an open question.

L:	Twenty years or something.
R:	Yeah, well say to build it. Well it depends, it just depends.
L:	See this one is a closed question. It's just a date.
R:	It can be an open cause sometimes like...
L:	Yeah I know sometimes. I know, I know, I know.

Although the students were still confused about the difference between open and closed questions, their discussion appeared to diffuse any anxiety they may have felt individually about their lack of understanding.

Interspersed throughout Libby's group's interactions were examples of playful exchanges. These exchanges were brief and appeared to be used to satisfy the need for some light-hearted humour during the concentrated activity. The group quickly brought themselves back on task as demonstrated in the following extract.

Time 162

Libby:	I'm doing my closed questions.
Jody:	(NVC – smiles and nods).
L:	(sarcastically) Did Aztecs have teeth?
J:	What?
L:	Teeth. Wow! (laughs)
J:	Aztecs (inaudible)
L:	This isn't – that's got nothing to do with temples.

Another interesting example of a playful exchange occurred at time 191 when the group appeared to be mimicking the teacher's response to Carly during the instructional phase as previously reported in Chapter Five.

Time 191

Kirsty:	What have you done?
Libby:	(pointing at questions) That and that.
Lorraine:	What Mira, what?
L:	What?
Lorraine:	What?
L:	What?
Lorraine:	I meant what?
L:	What?
Lorraine:	Yes, what?

L: What?

Lorraine: What area is...

L: Tease (laughs).

Lorraine: Is it closed or open?

L: Depends what question it is.

Lorraine: What sort of gifts did captured people send?

L: That would be an open question.

In a post-unit interview, Libby confirmed the benefits of being able to work collaboratively during the question writing activity.

Interviewer: How important was it for you to be working with K and J?

Libby: Quite important. I wouldn't have got as much information. We came up with the questions by ourself and then when we joined together in the group we chose the best questions and best answers that we got.

In addition to talking to her peers, Libby's rate of self-talk was higher than the other subjects. Libby engaged in self-talk during 15 separate 15 second intervals. Libby appears to use self-talk as a strategy to confirm her own knowledge and effort, to proof read her work, and as a way of organizing herself. Libby's self-talk was particularly prevalent after she had written something and then read it to herself for meaning. For example, at time 127 as she was half way through writing her keywords Libby said to herself "Temples, Aztecs, sacrifices." At time 133 Libby counted her questions to herself, and at time 139 as she started organizing herself for writing her questions, Libby stated "Closed questions. Now where's my pen?"

Analysis of work completed by Libby during the activity phase

Although Libby appeared to spend less time than Rewa actually engaged in writing, she was able to write for sustained periods after discussing her ideas with her peers. While Libby only wrote for a total of 7 minutes out of the 22.75 minutes allocated, she achieved the following output.

Topic: Temples

Key words = Temples, Aztecs, Sacrifices, Preist (own spelling)

Closed Questions – Who, When, Where

- Were children sacrificed?
- How many temples in Mexico?
- Did people watch the sacrificing?
- When were they built?

- How long did it take to build the temples?
- Did priests get sacrificed?

Open Questions – How, Why

- What did they do with the body after sacrificing?
- What were the different ways of sacrificing?
- Why did they build temples?

Libby wrote nine questions during the allocated 22.75 minutes. Her first six questions are correctly classified as closed questions, however her three questions classified as open questions are also closed questions. It appears that Libby has a similar misunderstanding to Rewa. Because there are a number of items Libby can list in response to her three 'open' questions, she may consider that they meet the criteria for open questions, specifically, that they can have more than one answer.

Libby's comments in post unit interviews demonstrate the level of her understanding of the difference between open and closed questions.

Interviewer: What is the difference between open and closed questions?

Libby: Open question's something that has quite a few answers and a closed question is usually either yes or no but can be like little ones like 1954 and stuff like that.

During the final 4.25 minutes whole class discussion phase of the lesson, Libby fiddled with various items but was observed to be attentive throughout.

In summary, although Libby did not fully understand the difference between open and closed questions, she was sufficiently confident in her understanding of the activity requirements to start the activity immediately. As reported in Chapter Five, Libby spent excessive periods of time during the instructional phase engaged in fiddling behaviour and gazing out of the window. These behaviours are likely to have been Libby's way of coping with the monotony of listening to information she considered she already knew. Libby appeared to have been listening selectively to those activity instructions she considered to be of personal relevance, in particular how to set out her work. Libby confirmed in post-unit interviews that she is able to "switch on and off" to what the teacher is saying, depending on how interesting she perceives it to be.

Libby does not consider herself to be a deep thinker as evidenced in the following interview extract.

Interviewer: What do you think the difference is between surface and deep thinking?

Libby: Think like just what you know, that's surface thinking I think. And then if you use that information for something else that would be deeper.

I: OK and what about you, where do you think, do you think surface or deep?

L: Surface (giggle).

I: So when the teacher was talking about that (thinking) what was going through your mind?

L: I can't really remember. I don't remember her talking about it.

In spite of Libby's misunderstandings, through being able to discuss her selected aspect and brainstorm possible questions with her peers, Libby was able to sustain on-task behaviour for 17.5 of the 22.75 minutes. As a result of being cognitively engaged with the activity, Libby succeeded in producing three pages of written work. Other than briefly requiring the teacher to spell a word, Libby's confidence in her own ability and understanding of the activity, and her collaboration with her peers, enabled her to satisfy both her need for social interaction and to work independently of the teacher. Due to the successful outcome of the activity, Libby was well prepared to undertake her subsequent independent research.

Rod's experience of the activity phase

Rod's behaviour during the activity phase was characterised by his confidence, independence, and strong sense of self-efficacy. Rod demonstrated a motivated, disciplined approach to the activity. In common with Libby, Rod was well prepared to start the task immediately. He had selected his topic and written his related key words during the previous session. He settled quickly to writing his questions and with the exception of the interactions with the teacher and trainee, completed the activity to his own satisfaction before allowing himself to engage with or be distracted by his peers.

As demonstrated in Table 17, Rod interacted with the teacher and trainee for a total of 2.75 minutes. This is significantly higher than for the other subjects. Rod appeared to enjoy these interactions and, unlike Rewa, was confident to ask the teacher questions and to seek clarification when required. Rod is regarded by the teacher as a particularly confident, able student whom she can challenge. This is evidenced in the following exchange between Rod and the teacher at time 122. At this stage of the activity phase, Rod had completed 2.5 minutes of sustained writing. Rod raised his hand and waited for 1.5 minutes for the teacher to clarify whether the following question was open or closed.

Rod: How any wars did they have and who were they against. Would that be an open or closed one?"

Teacher: I would think, what do you think first?

R: I'm not sure, probably both.

T: Yeah, I'd probably tend to put it in closed questions for a start...because there could be um, a closed, a number of answers but it should be in a finite set. All right, it should only be in a finite – you might not find all of those though because it would depend on how well they recorded them wouldn't it. Yep. What weapons did the Spanish have? Do you think that's an open question?

R: Yeah.

T: Why? Convince me.

R: Well, it might have lots of answers.

T: Yep, but is that an open question or a closed question? Would it still have a finite number of weapons? You tell me what weapons they had that you know of.

R: I don't know, like axes and swords and shields and stuff like that.

T: Okay, so if you went to a book could you find out pretty quickly what weapons they had?

R: Yes.

T: Yep, so it's a...

R: Closed question.

T: Yep.

R: Closed question.

T: Yep.

As demonstrated by the above example, the type of questions the teacher asked Rod were very different from those asked of Rewa. The teacher probed Rod's understanding, asking him to justify his responses and making him engage on a deep level. She persisted, going through his other questions and clarifying his understanding until she was satisfied that he could differentiate between open and closed questions. Rod continued to work independently until time 156 when the trainee teacher asked him how he was getting on. She spent one and a half minutes discussing Rod's questions and positively reinforcing his efforts. As demonstrated in the following extract, the trainee's comments were unhelpful in clarifying Rod's understanding of the difference between open and closed questions and may have resulted in adding to his confusion.

Times 156-160

Trainee: How are you?

Rod: Good. I need to think of some more open questions.

Tr: Are you doing war?

R: Yeah.

Tr: Yeah. How did the Spanish defeat the Aztecs? That's a good one. Um, what were the effects of the war? Cause that's really open like, they yeah um...

R: Yeah.

Tr: Um, why? Like the reason behind why the war started then how...

R: Why, why did the war start?

Tr: Yeah, you know how the Palestinians are at war at the moment?

R: Yeah.

Tr: There's a reason behind that. They don't – yeah, so there might have been a reason for the wars in – in Aztec which is a very open question cause it will take...But you don't want too many open questions cause like, why did the war start that's – would be quite a lot to find out about so that's probably, one more and that would be enough cause these ones are easier to find.

The message Rod was getting from the trainee was that one of the criteria for classifying a question as open was the length of time it may take to find the answer, and that open questions are therefore more difficult than closed questions.

Rod is also regarded as knowledgeable by his peers who often ask him for assistance. In contrast to Libby, Rod prefers to work independently of his peers. Rod is self-sufficient and tends to engage his peers mainly for social interaction rather than as a resource. Rod interacted with peers on content-related matters during five fifteen second intervals. His main interaction was with Elle and lasted one minute. As demonstrated in the following extract, Rod did not like being even mildly challenged by Elle when he suggested the Aztecs may have made weapons out of titanium. Rather than admit that he may not have known what kind of stone the Aztecs might have used for their weapons, Rod chose to screw up his face suggesting that Elle's question was not worthy of answering.

Times 166-169

Rod: (talking to Elle) Stop looking at my closed ones.

Elle: What are you doing?

R: Warfare.

E: So is mine.

R: Open one?

E: Have you got anything like what they made weapons out of?

R: No, but I already know that. Stone and wood and stuff.

E: What kind of stones?

R: (NVC – screws up face)

E: They could make it out of copper.

R: Iron, steel, titanium.

E: I don't think they had that in those times.

R: So? So? They could make it out of titanium.

In common with Libby, Rod uses self-talk as a way of organizing himself. For example, Rod stated "I need some more open questions," and a few minutes later "Now I need another open question."

On completion of the task, Rod spent the last six minutes of the allocated time gazing around the classroom and socially interacting with his peers about unrelated matters. The conversations were mainly centred around hair and eye colour, the cameras mounted in the classroom, and the students' individual microphones.

Analysis of work completed by Rod during the activity phase

Rod wrote a total of nine questions, three of which he classified as 'open' and six as 'closed'. All nine questions were self-generated and were of a consistently good standard. Rod produced the following work over a sustained period of seven minutes writing time.

Topic = Warfare

Key Words = power, warfare, wars, deaths, fighting, empire, citys (own spelling)

Closed Questions = who, when, where

- What weapons did they have?
- How many wars did they have and who against?
- How long was the war between the Aztecs and the Spanish?
- What weapons did the Spanish have?
- How many other civilisations have lived in Mexico?
- How many Aztec people were there?

Open Questions = why, how, what

- How did the Spanish defeat the Aztecs?
- Why did the war start?
- How did they find out about the Gods?

Rod's six closed questions are correctly classified. In common with Rewa and Libby, the questions Rod has classified as open questions, are also closed questions. The only question that could be considered to be suitable for inclusion in both categories is 'How did they find out about the Gods?' as it may be open to a range of interpretations according to the belief systems of the time and the way in which Aztec history was recorded.

Rod appeared attentive throughout the final 4.5 minute whole class discussion phase. He raised his hand to share one of his open questions but was not selected to respond.

In summary, Rod's self-sufficiency and knowledge of the task enabled him to comply with the teacher's instructions to work independently. He did not require any additional resources, other than to seek clarification from the teacher when he was unsure of one of his questions. The teacher's response was inconclusive and in a post-unit interview Rod recalled feeling stressed about the situation at the time. The interviewer was discussing the mood slip Rod had been given to fill out while writing his research questions. He had circled the following words to describe his mood: 'happy', 'stressed', 'interested', and 'energetic'.

Interviewer: Was there a reason for each one of them?

Rod: Well, cause I was happy, mm just like normal happy, and stressed cause um, like you had to do lots of work and I couldn't think of like some questions, cause I couldn't think of as many open questions. And I was a bit interested like what questions I was going to put and know what the answers would be, and just energetic.

It is apparent that Rod understood the purpose of the task and was motivated to complete it. Apart from reporting to feeling stressed at not being able think of many open questions, he managed to successfully complete the task well within the allocated time. As a result, he was well prepared to undertake his independent research in the following sessions.

Ned's experience of the activity phase

Ned's experience of the activity phase of the lesson was characterized by his high rate of off-task behaviour and correspondingly low rate of engagement. As demonstrated in Table 17 Ned's rate of engagement was half that of the other three subjects. Ned was at a disadvantage through having been absent in the previous session. He had not selected an aspect for investigation, or written any key words.

As discussed in Chapter Five (pp.193-194), Ned had clearly wanted to be involved in the discussions during the instructional phase of the lesson, but was not afforded the opportunity

to do so. Ned had raised his hand on five occasions during the instructional phase to answer the teacher's questions related to the activity. He was not selected to respond. Ned managed to ask the teacher one question related to organization. He also attempted to engage the teacher by calling out but was ignored. The lack of opportunity to clarify his understanding of the activity was an obvious disadvantage to Ned as he attempted to engage with the activity. Table 19 demonstrates the pattern of Ned's behaviour during the activity phase.

Table 19

Pattern of Ned's observed behaviour during the 27 minute activity and whole class discussion phase of Lesson One.

Time	Intervals (15 seconds)	Minutes	Event
105	1	.25	Asks T if he can work on mat
106-110	5	1.25	Gazing, sighing, talking to peer
111	1	.25	Writes heading
112	1	.25	Talking peer (Content-related)
113-125	13	3.25	Writing
126-128	3	.75	Talking peer
129-133	4	1.0	Hand raised, waiting for teacher
134	1	.25	Self-talk
135-156	22	5.5	Gazing, sighing
157-164	6	1.5	Talking peer (content-related)
165-179	15	3.75	Gazing
180-186	7	1.75	Moves to friend's desk, non-content related talk
187-191	5	1.25	Talking to teacher
192-195	4	1.0	Talking peer (non-content related)
196-200	5	1.25	Listening to whole class discussion
201-202	2	.5	Selected to read out question
203-212	10	2.5	Listening to whole class discussion

While Ned was physically at his desk for much of the session, his attention was elsewhere in the room for significant periods, as indicated by the amount of time spent gazing and watching others. The location of Ned's desk in relation to the peers with whom he prefers to work was also a disadvantage to him. Unlike Libby who sat with her friends, the teacher had strategically placed Ned's desk away from his peers as a way of managing his behaviour. The teacher confirmed her use of this strategy in discussions held during the study. The only way Ned could access his friends was publicly, thus increasing the risk of attracting the teacher's attention and possible censure for non-compliance with instructions.

Within the first one minute of the task Ned had selected warfare as his topic to research. Clearly wanting to work with his peers, Ned had one final attempt at asking the teacher if he could work collaboratively.

Ned: Miss H, say if you're both doing warfare, could you go on the mat and work out questions?

Teacher: You can go over there and work out questions but at the moment I only want them to be your questions. Okay?

Ned sighed in response and started writing questions one minute later. Ned wrote four questions in the following five minutes. Approximately one minute of this time was spent contravening the teacher's instructions by talking to his peers and asking them about their selected topic.

After writing his questions Ned was unsure if he had set the questions out correctly and wanted clarification as to whether he had to write one question per page. He attempted unsuccessfully to ask Jeff who was standing near Ned's desk. Jeff gave him an ambiguous answer as demonstrated in the following extract.

Times 126-128

Ned: Are you only supposed to do one question per page?

Jeff: What do you mean?

N: Like you write a question up and then you leave that page for all the things you're going to write down about it.

J: Miss H never said that so...

N: What?

J: Miss H never said that so...

Ned then raised his hand for one full minute to attract the teacher. Tiring of waiting he turned to two other peers for clarification and finally received the following definite but incorrect answer from Kirsty.

Times 133-134

Ned: Pat, are you supposed to do one question per page?

Pat: I don't know.

N: Kirsty, are you supposed to do one question per page?

Kirsty: No, you just write down heaps of questions.

N: Thank you.

Ned talked to himself saying "Okay, tactics." He was listening to Jeff counting his key words. Ned did the same saying to Jeff and Kirsty, "Oh how many keywords do I have? Two." Ned clearly wanted to continue his discussion with his peers but they moved off and he was again isolated at his desk. At this point Ned had clearly run out of ideas of his own. Unable to access his peers as a resource, Ned spent the next six minutes engaging in off-task behaviour, gazing around the room, and watching other students. Ned then risked censure for non-compliance with teacher instructions by engaging in a content-related discussion with a peer who had also selected warfare. The boys discussed their key words and questions, becoming involved in a discussion about the Aztecs and the Vikings.

Ned:	What about Vikings, trade with the Vikings?
Jeff:	They might have but I doubt it. The Vikings were like before them.
N:	Before them, are they? Ned then proceeded to erase Vikings from his page.
J:	Mayas probably. Like they might have gone to war with the Mayas.
N:	What civilisations do you know?
J:	The Maya.
N:	How do you spell that? (Jeff spells Maya and Ned adds it to his list of key words).

The above extract demonstrates that when Ned was able to access his peers as a resource, he became engaged with the task again through being able to discuss content-related issues. Ned again lost interest in the task and spent the next four minutes gazing around the room. Ned finally moved to his friend's desk and spent the next two minutes engaged in non-content related talk about social events in the classroom, in particular about Carly who was reported to have slapped one of the boys.

The first interaction the teacher had with Ned occurred at time 187, in the final two minutes of the allocated question writing time. It was obvious to the teacher that Ned had moved from his own desk and was talking to his friends when she approached Ned and asked to see what he had done.

Times 187-190

Teacher:	Right, which topic are you going to do?
Ned:	Warfare.
T:	Warfare. Surprise, surprise.
N:	Aztecs, maybe I'm bored.
T:	Yes, right, some questions.
N:	Four question, five, oh yeah, four.

T: Ah, I like that one. That's excellent because they certainly did have lots of tactics that they used. All right, and one of them had to do with – (picks up map sheet) and even though this is a map I've just made up but when you look...

N: Yeah, and on this I thought you, I didn't know you had to do questions.

T: Yeah, no, no, that's all right. You didn't have to do that part but you'll see if you look at a map of ancient, of the Aztecs and ancient Mexico that the mountains became quite an important part to their tactics and the sea where they decided to build their city.

N: The mountains would be quite important because they would fly arrows down.

T: Yeah.

The above extract illustrates the approach taken by the teacher to discussing Ned's selected topic. While the teacher's response "Surprise, surprise" could be interpreted as an attempt at humour, Ned's counter response of "Aztecs, maybe I'm bored" suggests that he perceived it to be more sarcastic than humorous. The teacher ignored Ned's comment about boredom and moved on in a very matter of fact manner to discussing his questions. Ned's interest in his selected topic was evidenced by his interaction with the teacher. It is of interest to note that the teacher did not comment on the fact that Ned had not complied with her instructions by moving to talk to his friends. She may have been satisfied with the fact that he had produced some work during the session.

Analysis of work produced by Ned during the activity phase

Ned wrote the following questions during the allocated 22.75 minutes of the activity phase.

Topic = Warfare

Keywords = Aztecs, Maya, warfare

Closed Questions - Who, when, where, what

- Who did the Aztecs fight with?
- What weapons did the Aztecs have?

Open Questions – How, what, why, who

- How did they win wars?
- What tactics did they use?

As with the other three subjects, Ned's four questions are theoretically all closed questions in that they could all have definitive answers. Although the two questions Ned has classified as 'open' would possibly require some in-depth research, they are no different from the two questions classified as closed questions.

Ned was the only subject to volunteer to share one of his open questions during the whole class discussion phase during the last four minutes of the session. Ned read his question "What tactics did the Aztecs have?" The teacher responded that tactics was not a topic that would be easy and that Ned would be required to interpret what the authors meant and to consult maps "and other things." As the teacher had discussed Ned's question with him two minutes previously, she was familiar with the question and obviously considered it worth sharing. By selecting Ned in this way, the teacher was endorsing his efforts and positively reinforcing him publicly.

Ned's experience during the question writing task raises a number of issues for further consideration. In spite of the fact Ned had been absent in the previous session and clearly felt the need to work with his peers, the teacher declined his request to do so. Once she had established that Ned had selected his topic she did not respond to his attempt to ask her a question seven minutes into the task, nor did she monitor his progress until the last two minutes of the session. Ned was able to write four questions on his own before running out of ideas. Ned wasted several minutes before accessing his peers. While engaged with his peers, Ned was able to clarify a misconception and to add another keyword to his list. Ned demonstrated on-task, engaged behaviour while using peers as a resource. It is possible that if he had been able to freely access his peers as a resource for the duration of the activity, Ned may have been able to sustain his engagement for a longer period of time, increasing his output as a result.

Ned's decision to finally leave his desk indicated that his need to break the monotony of his situation and to engage socially with his friends, took priority over possible associated risk. It was obvious to the teacher that Ned had moved from this desk and was talking to his friends when she approached him. The teacher's inconsistency in following up on her specifically stated instructions by not censuring Ned may confirm for him the risk involved in non-compliance with teacher instructions is limited, thus encouraging an opportunist approach to risk taking. In post-unit interviews Ned confirmed that some of the punishment given for non-compliance with the teacher's instructions, particularly when the punishment involves extra work, is preferable to the work they might have been expected to be engaged with at the time of their non-compliance.

Interviewer:	Is it a big risk to take to annoy the teacher?
Ned:	Not really, cause we just do it all the time. Not exactly big consequences.
I:	What sort of punishments would you be given?
N:	Like the most we've had to do is write a letter. Probably some of the work she gives me if I've been a bit naughty is sometimes better than the work I'm supposed to be doing.

Ned then laughed as he gave an example of a word study exercise he was given as a punishment for not doing his homework. "They were both boring (homework and word study) but the other one was less boring."

In summary, like Rewa, Ned was unprepared for the session. Due to his absence in the previous lesson, he had to try to interpret the teacher's instructions without any prior knowledge of the related activity. The interest and motivation to participate demonstrated by Ned during the instructional phase of the lesson visibly dissipated due to his lack of certainty about how to set his work out and the associated frustration and time taken to get the required clarification. Ned's writing was accomplished within 4.5 minutes and he successfully engaged his peers in content-related discussion for an additional 2.5 minutes. He spent a further minute discussing his questions with the teacher. Ned was off-task for the balance of the sessions (14.75 minutes). The limited opportunity Ned had to cognitively engage with the task through exchanging ideas with his peers, and the lack of teacher interaction until the last two minutes of the task restricted the amount of work he produced. As a result, Ned had a limited number of questions written which potentially compromised the quality of his subsequent research.

Teacher management of the activity phase of Lesson One

The teacher's management of the activity phase of Lesson One was characterized by the following aspects:

- Teacher accessibility to students
- Difference in interactions with individual students
- Use of questioning to probe student understanding
- Response to student questions
- Lack of reprimands

A discussion of these aspects follows, illustrated with examples from the data.

Teacher accessibility to students

At the conclusion of the instructional phase it was obvious to the teacher that several students were still confused about some aspects of the activity. Rather than extend the instructional phase, the teacher reassured the students that both she and the trainee would be available to assist individuals during the activity phase, stating: "I will be around to help you and talk to you. Miss W will be around to help you and talk to you."

The teacher and trainee spent the full 22.75 minute activity phase answering students' questions and enquiring about individuals' progress. In total, the teacher interacted with 18 of the 28 students during the activity phase. Immediately prior to dismissing the class to start the activity, the teacher demonstrated her knowledge of the needs of individual students stating: "I know that I'm going to need to catch up with Miles and Erin particularly. Being new to the class you might not know what to do." Three students including Erin, Miles and Mel were given substantial amounts of teacher time. The teacher's interactions with Erin were interspersed throughout a total of 20 fifteen second intervals. During this time the teacher was seated next to Erin's desk and made herself simultaneously available to other students. The teacher interacted with Mel during a total of sixteen fifteen second intervals, and with Miles, a new student to the class, over thirteen intervals. Other students to interact with the teacher for four or more intervals included Jed (10 intervals), Rewa (6 intervals), Ned (5 intervals), and Carly (4 intervals). An additional four students each interacted with the teacher for 3 intervals, and six students for one interval each.

As soon as the activity phase commenced, three students demonstrated their continuing confusion of the activity requirements by immediately asking the teacher basic questions related to procedures for setting out their questions.

Times 106-107

Max:	Um, what's the max questions we can have?
Teacher	Okay, let me come and have a wee chat to you. Yes Pat?
Pat:	When you write the questions is it just these?
T:	No, you can make up other questions. You don't have to just do those ones.
P:	Where do you do it on? On this?
T:	Yes. Open your booklet. Okay, you're going to write closed questions here, open questions here.
Kirsty:	So you don't write the answers?
T:	Don't write the answers. Just the questions on those pages.

K: Do we put it like this?

T: Yes please. Yes.

The teacher then moved straight to Miles' desk as promised, to check on his understanding of the activity and to ask if he had any previous experience of conducting his own research. For the next 2.25 minutes the teacher provided Miles with instructions for undertaking the activity, indicating the number of questions he should write and monitoring his understanding of open and closed questions. As demonstrated in the following extracts, the teacher's discussion with Miles provided him with far more specific instructions and details of the activity than she had provided to the whole class during the instructional phase.

Times 108 – 116

Teacher: Miles, have you done this sort of research before?

Miles: Oh we did one for our school. We were having a jubilee.

T: Yes.

M: We had to do um, draw a (inaudible) and we got these topics and we had to do a diorama on it.

T: Okay have you done, have you done them like, have you done things like closed questions, open questions, keywords, all those sorts of things before?

M: No.

T: Okay, so this is new to you. All right, lets go right back to the beginning then. You're still going to choose warfare as your topic?

M: Yep.

T: Okay, the keywords for warfare are words that are important. So, if you go to a book and you look up warfare then they're words that you would find mentioned quite a lot. They might be headings for example. Now, I can see one here already if I look. A keyword. It's going to be weapons, all right from your work. So...

M: Oh.

T: That's right. All right, in your keywords you would probably come across like five or six. Now in terms of your closed questions. Your closed questions you probably have more closed questions than open questions. Open questions like you might only have two or three. Your closed questions you might have six or seven. Just depends how, what sort of questions they are. So if we were having to look here, what weapons did they have? Is that going to be a closed question or an open question?

M: It would be closed.

T:	Right, because then you can just look in the books and find the answer. Why did they fight? Is that a closed or an open?
M:	Closed.
T:	Yes good. What kind of armour did they have?
M:	(inaudible)
T:	Closed. Yes, so you just write the questions along here.
M:	Can I write them there?
T:	You can, yes. Yes.

Satisfied that Miles was prepared to work independently, the teacher responded to another two students who were still confused about the activity. As she responded to their questions, the teacher realized that she may have confused some students during the instructional phase.

Times 116 – 118

Jasper:	Do we get to choose which one we get to do?
T:	An, yes Jasper, yes. Just wait a moment. Yes, but I'd like you to also go back and fill in your keywords. Yes.
Ashton:	Um, didn't you say only one question per page?
T:	Ah that's later.
A:	Oh.
T:	Okay, I think I confused a few people along the way Ashton. Write down all your closed questions on this page, okay. All your open questions on this page. Then what you'll do is you'll take one of your questions, write it here and then get your answer down.
A:	Oh, I see.

Teacher interactions and use of questioning with individual students

There was a noticeable difference in the way the teacher interacted with individual students during the activity phase. The way the teacher was prepared to spend significant periods of time with Miles to ensure he understood the activity requirements is evidenced in the previous discussion. There were also several other examples of the different ways the teacher interacted with students based on her understanding of them as individuals with varied needs, levels of confidence and self efficacy, and her perception of their abilities.

The most marked difference was the way in which the teacher used questioning in her interactions. In general, the type of questions the teacher asked to probe student understanding during the activity phase required students to think more deeply than those asked during the whole class instructional phase. The exception to this was when the teacher

was working with individual students who she considered to be lacking in confidence, or who may require additional support. In these cases, the teacher would scaffold the students' responses to her questions, or alternatively, would provide the answers for them. This was particularly evident in the teacher's interactions with two of the least confident students in the class, Erin and Rewa.

After responding to some general questions from students about procedures for setting out their questions, the teacher moved directly to Erin's desk to help her as she had promised to do at the beginning of the session. Erin was observed to be lacking in confidence and achieving at the lower end of class. The teacher spent the following five minutes seated next to Erin's desk, assisting her to clarify her understanding of the activity and providing suggestions for her questions. As with Miles, the teacher provided Erin with very specific instructions for undertaking the activity. As she started her discussion with Erin, the teacher realized Erin had changed her topic for the third time from markets, to farming, to temples. When discussing the concept of keywords, the teacher explained them as "important words to do with temples". As with Rewa, the teacher provided Erin with specific ideas for her questions. In contrast to Rewa however, the following extract demonstrates how Erin was allowed time to think and make suggestions of her own while the teacher assisted other students.

Times 136 – 140

Teacher:	Keywords are important words to do with temples. Can you think of any important words to do with temples?
Erin:	(inaudible)
T:	Sorry?
E:	(inaudible)
T:	Right, write it down. Okay, anything else? Okay.
E:	Temples.
T:	Anything else? Who are the people that are in the temples?
E:	Oh um, (inaudible).
T:	Okay, write it down. You'll find that this is very similar to the way that ancient Egypt was set up. You'll find a lot of similarities between the two. Okay, what else? What do they do at the temples?
E:	Sometimes they (inaudible)
T:	Sometimes, yes. Okay right you might add to those later after you've done some reading. You can always come back and add to them. Now you need to make up some questions...Okay, what's a question you could ask about temples that you don't know about?

While Erin was thinking about her questions, the teacher continued to answer other students' questions. One minute later Erin read her first question to the teacher. As the teacher responded she also asked Erin to decide what kind of question it was.

Erin:	Why are they there?
Teacher:	Right, now do you think that is a closed question with a very um factual answer, or was it going to be an open question?
E:	Closed.
T:	Right, so there we go. You've got your first question and you write it on that side.

When Erin had completed writing her first question, the teacher continued to extend her by asking her to really think about 'what' questions. The teacher then sensitively asked Erin if she knew what to do stating: "Can I leave you for a few minutes to see if you can design other questions?" Erin nodded and the teacher then moved to Rewa's desk to ask how she was getting on. As previously discussed, Rewa was another student who clearly did not understand the activity requirements and the teacher knew she would require additional assistance.

In this ability-streamed class, the teacher responded to the majority of students' questions in a way that would extend their thinking. For example, the teacher moved to Jed's desk and asked to see his open question about markets. The teacher positively reinforced Jed while encouraging him to expand on his question stating: "Yes, that's an interesting question. That's a good open question. All right, but instead of just saying why it was there, like markets, you need to expand your question a wee bit. Why did they use markets? All right, get the word markets in there as well."

In contrast, when the teacher perceived a student to be particularly able and confident, her interactions were noticeable for the way in which she challenged their thinking, often turning the question back to the student for further consideration. This was particularly with students like Rod and Carly.

As previously stated, Carly was a very confident, assertive student who had persisted with her questioning of the teacher during the instructional phase about the classification of questions beginning with 'what'. The following extract demonstrates Carly's continuing attempt to get the teacher to clarify the difference between open and closed questions, and in particular, one question that began with 'what'.

Times 157 – 160

Carly:	Um, would that be open or closed?
Teacher:	What have we got? Why did they sacrifice bodies who were alive, why didn't they sacrifice dead bodies?
C:	Is that the open one? Cause you don't really know if they're open or close until you actually find the answers.
T:	That's right. It could be, that could actually go in either of those because it's going to come back to a question that's about their whole religion. Also it comes back to if the people were dead, what happens to the blood in their body once they've died?
C:	It disappears.
T:	Why does it disappear? Where does it go?
C:	It rots away. Shall I just put it in what?
T:	You could choose which area at the moment. Right M, how are you going?

As demonstrated in the above extract, the teacher dealt with Carly's questions in the same way she had dealt with Rod's. Instead of providing Carly with definite answers, the teacher challenged her thinking and posed more questions for Carly to consider. The teacher terminated the discussion by quickly moving on to the next student thus preventing Carly from asking further questions.

The teacher's knowledge of individual students was also obvious in her interactions with Mel, the third student to have received a significant amount of teacher time during the activity phase. It was obvious that the teacher considered Mel to demonstrate his anxiety and negativity about certain classroom activities. At time 151 the teacher must have considered that Mel looked anxious as she stated: "Mel, don't panic." Mel simply responded with "Eh?" to which the teacher again responded "Don't panic." The teacher did not continue her conversation with Mel for another two minutes. She then moved to Mel's desk to ask how he was getting on. The teacher and Mel engaged in the following exchange before another student demanded the teacher's attention.

Times 160 – 162

Teacher:	Right Mel, how are you doing?
Mel:	I couldn't find the answer to it.
T:	Well hold on. Closed questions. So you're doing warfare are you?
M:	Yes.

T: Okay. So, who was involved in the fighting? Where did they fight? When did they fight? Okay.

M: That's what I'm trying to find out.

T: Can you think of an open question you could use using one of those words?

M: Why did they fight?

T: Right, write it down.

M: How did they kill each other?

T: Good thinking.

One and a half minutes later the teacher resumed her conversation with Mel and ended up having to address Mel's negativity towards reading.

Times 168 – 170

Teacher: Right Mel. Now are you ready to do a bit of reading to try to find some answers are you?

Mel: I hate reading books!

T: I know you do but you could find a book that has got some pictures in because you can see a lot with pictures can't you?

M: Mm-hm.

T: You can find a book that's got lots of maps in because we can find a lot of information about maps.

M: Yep.

T: Now, there's nothing wrong with your reading, you're actually quite good at it.

M: Yeah I know, but I don't like it.

T: Yeah I know, but you're going to find out the questions you want to find out aren't you? Okay, so go and get one book that looks as though it's about fighting and warfare.

The teacher then left Mel for one minute. When she returned Mel had found a resource book on warfare and the teacher continued to interact positively with him for a further two minutes.

Times 175 – 182

Teacher: Oh Mel, you've got a book? Sorry. Yes, good. Now what's that a picture of on the front.

Mel: A warrior.

T: Yes, okay. So what you want to do now is to have a look through the book and then see if it answers any of your questions. All right?

M: Yep.

T: Now could I just have a wee look through here. Right. Let's look at the contents first because this gives you a lot of ideas and also it's got the index at the back so if you were looking up particular things then you could look in the index couldn't you?

M: Mm-hm.

T: Okay, so for example if you wanted to find out about what weapons they used, you don't have to read the whole book, you can go straight to page twelve and thirteen and find out here about the weapons. Now we can see, what's this?

M: A bow and arrow.

T: That's right, okay. What's this?

M: It's a shield.

T: Okay, so now you've already told me two things, two of the weapons they use.

M: But that's not one of my questions.

T: No, I know that but if it was...

M: I could write that down.

T: You could easily write that down because you can see through the pictures.

M: Yeah.

T: Okay. You don't always have to just read through here. So the questions, who were fighting? So if we had a look at the contents here, going into battle. Perhaps that might give you some information cause they're getting ready to go and fight. Where did they fight? When did they fight? The fall of the Aztecs, that certainly talks about when they got killed by the Spanish – when the Spanish came across. So that's going to be about fighting.

M: Cool.

T: Okay?

M: Yep.

The above extract demonstrates how the teacher worked hard to encourage Mel to use his reading skills to access information. This was done sensitively and positively by the teacher with the result that by the end of the exchange, Mel's attitude had changed to being positive and he appeared motivated to continue with the activity.

Teacher responses to students' questions during the activity phase

In contrast to the type of responses the teacher gave to students' questions during the instructional phase, her responses to individual students during the activity phase were generally more specific and detailed as demonstrated in the following examples.

At time 152 Maggie asked the teacher if closed questions could only be answered with a yes or no. The teacher responded "No, but they normally have a fairly short answer. Don't have to be yes or no."

At times 164 – 168 the teacher checked Jed's questions for quality.

Teacher: Let's have a look at the quality of your questions. How what got there? Got that question twice. How they built the...

Jed: They made the schools like at the market, like how they sold it?

T: Right, just come over here for a moment. Okay, perhaps you could incorporate maybe two of those questions in one question. So, how did the markets get there and why were they used. Or and why were they important to the Aztec people. See the difference in questioning? Okay, so try and expand your question a little bit. All right and maybe run two of them together.

J: Cross off there and...

T: Yeah, don't – don't cross it all out because you're going to use those ideas still.

At time 191 the teacher moved to Jack's desk at his request.

Teacher: Right, what were you needing help with?

Jack: I don't know questions.

T: Okay. You're doing warfare, okay. How powerful are their weapons? Right, do you know which weapons they used?

J: That's what I gotta find out.

T: Okay, so that can be...

J: That's what I'm finding out here.

T: Oh sorry, okay. Um, who, have you got who did they fight with? Do you know who they fought with? Right that could be a question. So like, who were their enemies?

There are also examples of responses given by the teacher that were not definite or specific. An on-going concern for some students was the number of open and closed questions they were expected to write. As previously discussed, Ned had tried to find out this information

from his peers. Libby's group had reached consensus on what an appropriate number would be. It is of interest to note that the teacher gave Miles a definite number in her individual interaction with him (two or three open questions and six or seven closed questions). In the whole class setting however, her response to Jed was non-specific as it had been during the instructional phase. At time 129 Jed asked how many questions he had to do. The teacher decided to direct her response to Jed's question to the whole class.

Teacher:	Ah, can I just stop you for a moment please? People are asking how many questions. I said you could choose but you do, you'll probably have a lot more closed questions than you would have open questions. Because of course open questions would take you a lot longer to find the answer to.
Jed:	Is four enough?
T:	Depends if – depends what your questions are Jed. Think carefully about them, especially your open ones. Right?

It is unclear why the teacher did not give Jed the same response as she had given Miles. While the students could have still decided how many questions they wrote, the teacher had suggested a number of questions to Miles that she would have considered would be sufficient to base his subsequent research on over the following three weeks. This information would have been beneficial to all students, as it became clear as the unit progressed that some students had insufficient questions on which to base their research.

Lack of teacher reprimands

In contrast to the 19 reprimands or requests for students to pay attention during the instructional phase of the lesson, the teacher only issued one reprimand during the activity phase. The reprimand was given to Jasper at time 186, approximately 20 minutes after the start of the activity phase. The teacher had been watching Jasper obviously doing something she considered to be inappropriate and asked "Is this sensible?" Jasper shook his head in response and the teacher stated "Right, I can tell from the look on your face. Go and sit down."

There are a number of possible explanations for the lack of reprimands during the activity phase. First, because the teacher was often engaged in lengthy interactions with individual students in different areas of the classroom, it was more difficult for her to monitor the behaviour of individual students than in the whole class instructional phase. Second, as the teacher was circulating around the classroom, the majority of students would have appeared to be actively engaged with the question writing activity. The data shows that this was not the case with students like Rewa and Ned, who spent lengthy periods gazing around, watching

and listening to others. The data also shows that while many of the students appeared to be actively engaged with the activity and each other, the teacher would not have been able to monitor the content of their conversations, many of which were non-content related. In spite of her explicit instructions for students to work on their own, the teacher was clearly prepared to compromise and allow the students to interact if the noise level was not excessive, and if the students appeared to be on-task.

The teacher's acceptance of students' non-compliance with her instructions raises an interesting issue for consideration. The teacher's clearly stated philosophy was that students learn from each other and in collaboration with each other. She was also aware that the choice of the Aztec topic was difficult in that none of the students had any prior knowledge of it. In theory, opportunities for students to discuss and share their developing knowledge would have been consistent with the teacher's philosophy. In addition, the teacher had stated that after the first week of independent research, students with similar interests could join together to present their research. Some students may have interpreted her comments to mean that they could collaborate from the start of the research component of the unit, rather than wait for a full week to work together.

These issues raise the question of why the teacher insisted that the question-writing activity had to be done individually. A possible explanation is that it was used as a management strategy. As demonstrated in the analysis of the instructional phase, the teacher had struggled to maintain her management of the students. By stating that the activity was to be done individually, the teacher may have thought this would have helped her to manage the students more effectively.

Teacher management of the final whole class discussion phase of lesson one

The teacher allocated the final 4.25 minutes of the lesson to whole class discussion of students' questions, and to briefly outline the following research sessions. The first three minutes were spent with the teacher selecting students to read out their questions. The teacher was particularly interested in the students' open questions stating: "As I was going around I was reading some of the questions. There were some interesting open questions. Remember the open questions are the ones that I want to see you really thinking deeply about. It depends though on the quality of your questions." The teacher selected Erin to read out an open question she had previously noticed her writing. It is interesting to note the way the teacher introduced Erin's question, indicating that it wasn't entirely her own work.

Teacher:	Erin, I'd like you to read your open question that you've got there because that was quite a good one. I think she overheard me talking to Maggie a wee bit but used it in her open question. So in a big loud voice.
Erin:	How are temples related to ancient Egyptian pyramids, times etcetera?
T:	Okay so it was look at temples but also relating it to another civilisation, ancient Egypt.

Ned was the second student selected to read out a question that the teacher had been discussing with him only three minutes previously. Selecting Ned to read his question was beneficial to Ned. Because of Ned's occasional challenging behaviour, he was rarely selected to contribute publicly or to have his efforts positively acknowledged in front of his peers. The teacher would also have remembered Ned's slightly sarcastic exchange with her earlier in the lesson about being bored with the topic. Selecting Ned may have provided him with additional motivation to apply himself to the research project.

Teacher:	Has anybody else got what they consider is a pretty good open question that's going to make them really think? Ned?
Ned:	What tactics did the Aztecs have?
T:	When they were?
N:	Battling.
T:	Right, so Ned's topic's obviously warfare. Perhaps you need to tell us your topic before you tell us your question. All right, tactics is not one that's going to be very easy. It's going to require Ned to interpret what the author means in some of the books and have a look at maps and other things.

The last two students to be selected were Elle and Toby.

Elle:	My topic's about warfare and it's um, what did they make their weapons out of like, was the handle that they hold onto it made of or some stone or where there any precious gems on it?
Teacher:	Thank you. Toby?
Toby:	My topic's warfare. How did they make their weapons?
T:	Right.

While the teacher had asked students for open questions, three of the four questions were closed. Only Erin's question could be correctly classified as open. The teacher's response to Ned shows that she was equating open questions with the time and effort that might be required to answer them, rather than the fact that there would likely to have been information

recorded on the tactics used by the Aztecs in warfare. Libby and Toby's questions were clearly closed. Rather than attempting to further differentiate between the types of questions, the teacher accepted all four questions, positively acknowledging them with "Thank you" and "Right." Students who were attending to the discussion, and who might have been comparing their own questions with the examples provided, may well have considered their closed questions to be open questions, therefore mistakenly believing they had met the requirements of the activity. The inconclusive nature of responses to students' questions demonstrates the personal difficulty the teacher had in publicly articulating the difference between open and closed questions. The final comments made by the teacher were in relation to the use of books to find the answers to questions. Using her interaction with Mel, the teacher reinforced the value of illustrations.

Teacher: Remember and it was as I was talking to Mel as we were having a look in his warrior book because he's doing warfare as well, that I was telling him too, the importance of making sure you read the pictures as well as reading the text. Remember the pictures give us a lot of information. They give us extra information sometimes than the text gives alone. Remember the maps give us information too.

This comment would have been beneficial to all students, and in particular, would have reinforced for Mel the teacher's previous discussion with him about the value of reading to access information.

During the final 1.25 minutes of the lesson the teacher briefly stated that there would be topic sessions twice daily for the next week to enable students to find information about their selected topics prior to going on to the presentation stage. The teacher then collected the topic booklets to check the research questions.

As demonstrated in this analysis of the teacher's management of the activity phase, there were significant differences in her interactions with individuals as opposed to her interactions during whole class discussion phases during the introductory and instructional phases of the lessons. At times, the teacher clearly demonstrated her understanding of the needs and abilities of individual students. The use of positive reinforcement to encourage and motivate was obvious.

At the end of the session however, many students were still confused about the difference between open and closed questions. The teacher had run out of time to clarify their misunderstandings. She would also have realised that if she attempted to spend more time in

a whole class teaching session, she would risk losing the students' interest as had happened during the instructional phase. It would have been obvious to the teacher that it would be preferable to assist individual students during the following week as they worked on their research. In the following post-unit interview the teacher acknowledged that after reading the questions she realised most of the questions were closed, but did not have the time to spend on clarifying the students' misunderstandings.

Interviewer: Were there any sessions or activities that you felt were not successful?

Teacher: The group work for a start, well, the research took a while to get off the ground. I would probably... we sort of rushed through like the key questions, the closed and open questions and all of that, even though we'd done it before. Probably would have spent more time... looking back I probably would have kept the unit going for the whole term in a bit more detail so that the research process could be extended and the closed and open questions, you will have noticed that some of them... they called them open questions but they were all closed. And we didn't really have the teaching time to go back and say hey, this is really a closed question, it's not your opinion, you're still getting the factual knowledge straight from the book. That type of thing.

This last extract is considered to be significant. The success of the following three weeks of independent research would be determined by the quality and variety of research questions the students designed. In summary, the data suggests that there was a very fine balance between the way in which students and the teacher managed the activity. Providing the students appeared to be actively engaged and complying with the teacher's instructions, there was an unspoken understanding that everything was proceeding satisfactorily. As with the instructional phase, the focus for some students appeared to be on the process of setting the work out correctly, rather than on the content of the questions. Due to time pressures and issues related to student motivation and management, the teacher was prepared to compromise the outcome of the unit by not ensuring that the students understood the difference between open and closed questions. This raises the issue of the status of knowledge in this particular classroom activity, and more generally, in primary and intermediate classrooms. After five years in the school setting, students appear to have learned to 'play the game' in terms of compliance with the teacher's instructions and the demands of the task. Teacher monitoring of students' understanding of task requirements, and their formative assessment of students' knowledge as they carry out tasks, is often limited. It is argued that students can meet task requirements often with a minimum time and

effort and at times having to engage only superficially with the concepts which were the purpose of the task. This issue is discussed more fully in Chapter Eight.

Analysis of the activity phase of Lesson Two

As with the analysis of the activity phase of Lesson One, the focus in the analysis of the activity phase of Lesson Two is on the four students Beth, Elle, Jeff and Jack. The analysis includes the individual students' experience of the activity phase, including their observed behaviour, engagement with their assigned group task (chemical pop guns or boats), and their interactions with the teacher and their peers. The statements written by the four subjects during the report writing phase of the lesson are analysed for content. This is followed by a detailed analysis of each selected subject's concept knowledge based on their pre and post-test answers and from their interview responses. Factors relevant to each subject's concept knowledge are discussed. The section concludes with an analysis of the teacher's management of the activity phase of Lesson Two, including the teacher's management of resources and student behaviour; monitoring of student compliance with their respective task instructions; use of questioning during whole class discussion phases, and management of the report writing phase. A full description of the two tasks designed to be undertaken during the activity phase of Lesson Two is provided in Chapter 4 (pp. 160-161).

The activity phase of Lesson Two was comprised of 26.5 minutes, followed by a 4.5 minutes report writing phase. The structure of the activity phase is demonstrated in Table 20.

Table 20

Structure of the 31 minute activity and report writing phases of Lesson Two

Time	15 second intervals	Minutes	Event
74-93	20	5.0	Group experiments
94-100	7	1.75	Settling inside classroom
101-106	6	1.5	Discussing failed experiments
107-136	30	7.5	Group experiments
137-144	8	2.0	Settling inside
145-158	14	3.5	Discussing pop guns and saturation
159-166	8	2.0	Discussing boat experiment
167-172	6	1.5	Settling to watch boat experiment
173-174	2	.5	Watching boat experiment
175-179	5	1.25	Settling at desks
180-197	18	4.5	Report Writing
Totals	124	31	

As demonstrated in Table 20, the teacher had allocated 26.5 minutes to the activity phase. The actual time available to students to conduct their group experiments was 12.5 minutes. Of the remaining 14 minutes, 6.5 minutes were spent while the teacher waited for the students to comply with her requests to pay attention and listen to further instructions. An additional 7 minutes were spent in whole class discussion of the failed experiments and related concepts, and 30 seconds were spent watching one group's boat experiment.

Group organisation and the allocation of group activities

The teacher had randomly assigned the students into six groups with four or five students in each. The students were expected to work in their assigned group for the duration of the unit. Three of the groups were allocated the chemical pop-gun activity. The other three groups were allocated the boat activity. As both the groups and activities were assigned by the teacher, the students had no choice of who they would like to work with or which activity they would prefer to work on first. As previously discussed, the majority of students wanted to carry out the pop-gun experiment first. Beth, Elle and Jeff were in the groups that had been assigned their preferred choice, the chemical pop-gun activity. Jack was the only subject who was not assigned his preferred activity. His group had been assigned the boat activity.

Individual subjects' experience of the activity phase of Lesson Two

The following section includes the analyses of the individual subjects' experience of the 26.5 minute activity phase and the 4.5 minute report writing phase. The subjects' behaviours have been summarised in Tables 21, 22 and 23.The tables are followed by a detailed description of each subject's experience of the activity phase. Analyses of the subjects' written reports and their understanding of the related concepts embedded within the activities are included.

Summary of subjects' behaviours

Table 21 provides a summary of each subject's engagement and other behaviours during the 26.5 minute activity and discussion phases. The totals represent the number of fifteen seconds intervals each subject was observed to engage in a specified behaviour. The subjects may have engaged in more than one behaviour in a single interval.

Table 21

Individual subjects' behaviours during a 26.5 minute activity and discussion phase within a 49 minute science lesson.

Time in 15 Second intervals	Total Intervals	Total Minutes	Individual Subjects behaviours			
			Beth	Jeff	Elle	Jack
74-93	20	5	Watching another group's pop gun experiment	Active involved in group pop gun experiment	T with 1 min. Active involved in popgun. Watches another group 2 min	Fillinf water trough for boat experiment
94-100	7	1.75	Moves inside	Moves inside	Moves inside	Continues to fill trough
101-106	6	1.5	Attending to T Hand up x 2	Attending to T Hand up x 3	Attending to T Hand up x 6	Attends to T Hand up x 3
107-136	30	7.5	Watching p.g. experiment x 30 Joins up with new group of girls Passive role only	Active/involved in p.g Instructs others predicts x 20 Watches another group's Experiment x 10	Active/involved In own group Experiment x 24 Watches another group's experiment x 6	Plays with water at trough x 4 Starts own p.g experiment x 5 Active/involve d in another group's p.g experiment x 17 Engages with own group x 4
137-144	8	2.0	Moves inside	Moves inside	Watches experiment x 4 Moves inside	Watches experiment x 6 Moves inside
145-158	14	3.5	Watching and listening	Watching and listening Hand up x 1	Watching and listening Hand up x 4	Watching and listening Hand up x 3
159-166	8	2.0	Watching and listening	Watching and listening	Watching and listening	Talking to self and peers x 3 Watching and listening x 5
167-174	8	2.0	Watching boat experiment	Watching boat Experiment	Watching boat Experiment	Talking to peers x 4 Watching boat experiment
175-179	5	1.25	Returns to desk	Returns to desk	Continues to watch boat x 3 Moves to desk	Continues to watch boat x 3 Moves to desk

Summary of subjects' engagement in their assigned group activities

Table 22 provides a summary of the individual subject's engagement with their respective group's assigned activity.

Table 22

Percentage of time engaged by the subjects in a 12.5 minutes group activity phase within a 49 minute science lesson

Subject	% of 12.5 mins engaged in own group's activity	% of 12.5 mins engaged in observing another group's experiment	Other
Beth	Nil	100%	
Jeff	80%	20%	
Elle	72%	28%	
Jack	8%	Nil	Filling/playing with water trough 50% Conducting own experiment 10% Taking over another group's experiment 32%

Summary of subjects' engagement and observed behaviours during the 4.5 minute report-writing component of Lesson Two

Table 23

Subjects' behaviours during the 4.5 minute report writing activity in a 49 minute science lesson

Time in 15 second intervals	Total intervals	Total minutes	Individual Subject behaviours			
			Beth	Jeff	Elle	Jack
180-197	18	4.5	Immediately complies with T instructions Fully engaged in writing and reading own report	Immediately complies Engaged in writing report x 10 Listens to T discussion of unrelated concept (CuSO4) x 7	Fiddles Talks to pupils x 6 Report writing x 10 Slapping mic x 4	Complies within ½ minute Report writing x 8 Engaged with T about CuSO4 discussion x 1 Ignores T request to hand in topic book
Total time spent writing report			17/18 4.25 mins	10/18 2.5 mins	10/18 2.5 mins	8/18 2 mins

Table 23 provides a summary of the subjects' engagement and behaviours during the 4.5 minute report writing activity.

As demonstrated in Tables 21, 22 and 23, there was a wide variation in the subjects' behaviours, the extent to which they participated in their respective group activities, and the time they spent engaged with the report writing activity. This variation is demonstrated in the following analysis and discussion of each subject's experience of the activity and report writing phases of Lesson Two.

Individual subjects' experience of the activity phase of Lesson Two

Beth

Beth's experience of the activity phase is unique in that she spent none of the allocated group experimental time with her own group. When instructed to move into groups, Beth moved to the back of the class to get her group's box of equipment. Once outside, the boys in her group quickly dominated the resources, including taking from her the bottle of vinegar that she was carrying. Beth appeared to immediately resign herself to the role of passive observer, making no attempt to be assertive or to ask to be included in the experiment.

Realising that she would not get an opportunity to participate in her own group's experiment, and due to the implied rather than specific instructions for students to stay in their allocated groups, Beth left her group and watched other groups experimenting outside. Beth's experience of being marginalised within her group was common to at least four other girls in the class who also wandered around on their own observing other groups during the activity phase of the lesson. Beth occasionally stood with one or more of the four girls, but continued to watch passively rather than engaging with them or getting involved in the extreme excitement of the other students around her.

Beth's level of social interaction was extremely limited during the 49 minute lesson. Beth was observed to have only three brief interactions with her peers. The first interaction was with her friend and occurred 27 minutes into the lesson. The second interaction occurred two minutes later as Beth was watching a group experiment with the same friend. The third interaction occurred four minutes later. Only one student was observed to initiate conversation with Beth, or to engage her in any other form of social interaction. This student was the girl Beth had identified in the post-unit interview as the person with whom she enjoyed working with the most. As a result, Beth had few opportunities to exchange information or to extend her own knowledge of the experiments through discussion with her

peers. Due to problems with Beth's microphone there is no record of the content of the interactions. As each interaction lasted 15 seconds or less, it is unlikely they were content-related.

During the whole class discussion phases of Lesson Two, Beth raised her hand twice in response to the teacher's request to demonstrate the students were paying attention. Beth did not offer to answer any of the teacher's questions related to the concepts.

Beth's behaviour in Lesson Two is typical of the behaviour she demonstrated throughout the unit. Beth was observed to spend significant periods of time without initiating any form of social interaction with the teacher or her peers. Beth appeared to prefer to interact with the teacher or her peers on an individual basis rather than publicly or within a group. When students were given a choice to work individually or with a group, Beth often chose to work on her own or with one other student (her best friend). At times during whole class discussions, or when the teacher was giving instructions, Beth would rest her head on her arms, closing her eyes or averting them downwards. The teacher did not comment on this behaviour or insist that Beth sit up to listen.

Occasionally Beth would volunteer to take an active role within a group context, however would not assert herself if challenged by more dominant students. Her response in such situations was to withdraw and adopt the role of passive observer, or as was demonstrated in this lesson, simply remove herself from the group without comment, and if the opportunity presented, go and watch other groups.

From the video-cued interviews conducted with Beth at the conclusion of the study, it is obvious that Beth's perception of her level of participation differed considerably from that of the observer's records. At the conclusion of the science lesson held the following day, the teacher let those students who had missed out on making the pop-guns during the previous session have a turn. Beth and several other girls were observed to drift around outside, appearing to be detached from the other students. The teacher noticed this and intervened, suggesting that the girls form their own group, get the required equipment, and conduct the experiment together. The girls did this but Beth continued to be a passive observer within the group. When interviewed about the experiment it appeared that Beth regarded her own level of participation to be much higher during the period of time spent in the all-girl group. Beth stated:

> When we did the chemical pop-guns, we asked the boys if we can join in but they didn't let us so we were waiting. So were the other girls in the class so we decided to make one for ourselves. So we did, and it worked. It was alright watching all the other ones but I sort of wanted to have a go as well – a lot funner. And it was

cool. It felt good or happy. Like, when we did the chemical pop-guns we didn't think ours was gonna go but it did. Well, it was really exciting cos it actually went quite quickly.

It appears that Beth was equating excitement and fun with an increased sense of active participation even though this was contrary to what was actually observed to have occurred. One further comment made by Beth is of particular interest. Beth stated: "You've got to learn that you can't always get your way." This comment is consistent with later comments Beth made about the difficulties she had getting a turn to participate in science activities.

Beth's experience of the report writing phase of Lesson Two

In her written report at the end of the lesson where students were required to write two new things learned during the lesson, Beth wrote the following:

- I learnt that when you make cemical pop-guns it's important to put the write amount of vinegar or baking soda in it.
- I learnt that you've got to be pacient (own spelling).

It would be of interest to know if Beth's comment about the need to be patient related to the need for her to wait for the chemical reaction and subsequent explosion to occur. An alternative interpretation might be that she was either consciously or subconsciously recalling her experience of needing to wait to take a turn without success.

Analyses of Beth's concept learning

Beth's written and oral responses to pre-test and post-test items relevant to the selected concepts.

Item 16: A bottle has a mixture of vinegar and baking soda in it and is sealed by a cork. What makes the cork pop out of the bottle?

Written responses

Pre-test: The pressure fizzes up and there's no air left so it pops out.

Post-test: When the mixture is in it, it fizzes up and there is no more oxygen so the cork pops out.

Oral response in post-test interview

Beth: Well, what happens is... there's no more oxygen left in the thing. And there's no...cause when it comes up, if you don't put enough of the vinegar or the baking-soda or you put too much of it, it will only go up a little bit,

but if you put the right amount in the thing. And so the pressure inside it pushes it out.

Interviewer: How did you find that out, or how did you work that out? Did somebody explain it to you or did you work it out for yourself?

Beth: Well, when we actually did the experiment...They didn't really explain it to us... I did think about it though.

Analysis of all responses to item 16

Beth's basic understanding of the concept did not change. Beth understood that the overall effect was the production of fizz, however she was unable to identify that the fizz was the result of the chemical reaction between the vinegar and baking soda. She had a vague understanding that pressure was somehow related to the concept but was confused about the effect of the pressure. In the pre-test she stated that it was the pressure that fizzes up, rather than the result of mixing the ingredients. Beth's post-test response demonstrated her understanding that the fizz was the result of the mixture, not the pressure. At one point she demonstrated her understanding of the need to mix the right ratio of ingredients so that it (presumably the fizz) goes up and up until there's not more pressure. She then qualified her response by stating that as there was no oxygen left, the pressure pushes the cork out.

Item 19: This is what happens when you put baking soda into an acid. Fill in the missing name. Acid + carbonate = ----------+salt + water

Written responses

Pre-test: molecule

Post-test: fizz

Oral response in interview

Beth: I don't know that one.

Interviewer: That's OK. The missing thing is the gassy bit. The bubbly bit.

B: Oh, the fizz.

Analysis of all responses to item 19

Beth was unable to demonstrate her full understanding of the production of carbon dioxide as a result of the chemical reaction between an acid and a carbonate. Beth's post-test response indicates her understanding of the physical manifestation of the effect (the fizz), however she was unable to state that it was carbon dioxide. In the interview, with prompting Beth was again able to recall her written answer, the fizz, but indicated clearly that she did not really know the answer.

Item 3: Which of these are acids? (There could be more than one)

Chalk

Rain Water

Lemon Juice

Vinegar

Dishwasher Liquid

Coca Cola

Written responses

Pre-test: Lemon juice, vinegar.

Post-test: Lemon juice, vinegar, dishwater liquid, Coca Cola

Oral responses in interview

Beth: I don't really know what an acid is but I do know that an acid...like when it goes with a chemical and makes a...I mean, when it goes with a carbonate and makes a reaction...and I put down lemon juice, and the dishwasher liquid and the vinegar.

Interviewer: How do you think you learned that? Can you remember it being talked about?

B: An acid will, like I said, I remember that the acid, when you put something with it, it's making a chemical reaction. That's why I put down vinegar and that. And then we had to put them into piles of which were the acids and which were the carbonates.

I: Did you try out some of acids and carbonates and mix stuff?

B: Yeah. I wasn't there on the day so I made it at home.

I: What did you mix up at home?

B: I made the sherbet and I tried the citric acid and the tartaric acid.

I: Would you have know anything about that before doing the topic?

B: No, not really. I would have known about the vinegar cause we made volcanoes.

Beth explained about an experiment she had done in her class the previous year.

B: We had to make volcanoes and you had to make them out of papier mache. We didn't have to but some people did. And then you put vinegar and baking soda together and they reacted, and it came out the top.

Analysis of all responses to item 3

Beth correctly identified two acids, lemon juice and vinegar, in both the pre and post- test. In the post-test however, Beth demonstrated her misconceptions of two items in the list by incorrectly identifying dishwasher liquid and Coca Cola as acids. Although she was able to identify two acids, Beth was unable to state what an acid was in the interview.

While giving her oral responses, Beth made links to her previous experience of sorting acids and carbonates into their respective groups. She also drew on her previous experience of mixing baking soda and vinegar together when making a volcano. Beth was able to state that when an acid is mixed with something, it makes a chemical reaction. Beth did not identify the 'something' as a carbonate.

Item 6: What do we call something that will make bubbles if it is added to an acid?

A gas

Carbonate

A powder

Carbon dioxide

I don't know

Written responses

Pre-test:	carbon dioxide
Post-test:	carbonate

Oral responses in interview

Beth:	A carbonate.
Interviewer:	Right, a carbonate. When do you think you learned that?
B:	Well, maybe at the start of when we did it. Cause she was telling us about it. We had to...I can't remember. Like when we did the pop-guns. They sort of helped. When we were doing like,...when you had to do the...we had to put them into like the carbonates and the acids.
I:	Did you know that before the topic?
B:	No. I didn't know.

Analysis of all responses to item 6

Beth demonstrated her learning of the concept by correctly identifying a carbonate in the post-test. Beth recalled hearing the teacher talk about it during the start of the lesson. She also recalled her previous experience of sorting acids and carbonates into groups.

Written responses to items 12 to 14

Items 12-14: All related to the irreversible changes that occur as a result of chemical reactions

Item 12: If we mixed up some baking soda in lemon juice, it would fizz or make bubbles. After it has stopped fizzing, is there any way we could get the baking soda out of the lemon juice?

Item 12: Pre-test:Yes

Post-test: No

Item 13: Why do you think that?

Item 13: Pre-test: I don't know

Post-test: Because it's already dissolved into the lemon juice.

Item 14: What do you think happens to the baking soda?

Item 14: Pre-test: Dissolves

Post-test: Don't know

Oral responses in interview

Beth: Well, I don't really know but that could be a yes...Because like the salt one, but these are different things to I don't really know, but they could be...I probably put yes (in the test), but I don't really know that.

Analysis of all responses to items 12-14

Beth gave the correct response to item 12. From her answers to items 13 and 14, and from her interview responses, it is clear that Beth did not understand the concept of the irreversible nature of chemical reactions. It must be assumed therefore, that Beth's correct response to item 12 was likely to be a guess.

Beth's response to item 13 demonstrates her confusion between dissolving and a chemical reaction. Her responses to item 14 show some shift in her thinking between the pre and post-tests. Although she did not know the answer, she was sufficiently unsure that it was due to dissolving to not write dissolving as her explanation. Beth's interview responses confirmed her continuing confusion between chemical reactions and dissolving. Beth tried to link her thinking to previous knowledge of the way in which salt dissolves and can then be extracted through the process of evaporation. Because vinegar and lemon juice were different substances to salt, Beth was unsure of whether the baking soda could be extracted once mixed. This indicates Beth's continuing confusion between the process of dissolving and

chemical reactions. Beth does not understand the irreversible effects produced by chemical reactions.

Beth's written report for the chemical pop-gun and boat tasks.

Beth wrote the following two sentences in response to the teacher's instruction for all students to write two sentences about something else you've learned today.

- I learnt that when you make chemical pop-guns it's important to put the right amount of vinegar or baking soda in it
- I learnt that you've got to be patient.

Analysis of Beth's written report

Beth's understanding of the need to add the correct ratio of ingredients to obtain the desired effect is demonstrated in the first sentence. Beth's second sentence is open to dual interpretation. First, it could relate to Beth's understanding of the need to wait patiently for the reaction to occur. From her responses during the post-unit interviews, it could also relate to the need to wait patiently to use the resources and to participate in conducting science experiments.

Beth's response to questions relating to interest, enjoyment, and difficulty

Included at the end of the pre-test were some questions relating to students' perceptions of how they thought they would enjoy the unit, and how difficult they thought it might be to understand the content. These two questions were included in the post-test in addition to a question relating to how much they thought they had learned, and one about their preferred activity. The questions were also asked during the post-unit interviews. The questions and Beth's responses follow.

Do you think you'll find this topic on fizzes and chemical and molecules and atoms very interesting, a little bit interesting, a little bit boring, or very boring?

Pre-test: very interesting
Post-test: very interesting
Interview: Quite an interesting topic because I learned a lot.

What was the activity you enjoyed the most in this topic?
Post-test: hokey pokey, sherbet, and chemical pop-guns
Interview: The chemical pop-guns and the candle one.

Do you think you'll find this topic on fizzes and chemical and molecules and atoms very hard to understand, a little bit hard to understand, mostly easy to understand, or very easy to understand?

Pre-test: mostly easy to understand

Post-test: a little bit hard

Interview: (not asked)

During this topic on fizzes and chemicals and molecules and atoms, how much did you learn? A lot I did not know, some things I did not know, one or two things I did not know, nothing I did not know.

Post-test: I learned some things I did not know

Interview: I learned a lot because I used to not know much about science

Factors relevant to Beth's concept learning

As demonstrated in Table 14, Beth displayed a high rate of appropriate attending behaviour (presumed watching and listening), during the whole class teacher-led discussion and instructional phases of the lesson. Although Beth does not take advantage of opportunities to participate in whole class discussions, she confirmed in interview that she listens and thinks about what might be going to happen during such discussions. Beth's correct response to post-test item 6 may have been the result of her listening to and retaining the teacher's explanation of a carbonate in the whole class discussion phases of the lesson.

The fact that Beth does not participate in whole class discussions can be considered to be a distinct disadvantage in other ways. Through her reluctance to raise her hand in response to teacher questions, Beth is unable to demonstrate her knowledge publicly or to take full advantage of the opportunities for cognitive engagement. As a result, she does not receive positive reinforcement for correct responses, nor is she able to have her misconceptions corrected. Beth's lack of participation gives her peers no understanding of the status of her knowledge. This may negatively impact on her peers' perception of her ability, and in their regard for her as being a preferred working partner or group member.

Beth does not appear to enjoy high social status amongst her peers. The lengthy period of time Beth is able to sustain with little or no social interactions with her peers almost makes her 'invisible'. She has two or three friends within the class whom she identifies as girls she enjoys working with. Beth is sensitive about those occasions when she gets excluded from group activities. "I maybe get sad when like I don't get picked to do things that my friends do because like they all get a go and I don't even they sometimes I go and they don't. But it just makes me feel sad." Clearly Beth wants to be involved and reports to be excited when the

class is involved in science experiments. Due to her lack of assertiveness, it appears that Beth accepts the role of passive observer and that much of the excitement she comments on is the excitement she sees demonstrated by others. Beth's comment that "the hardest part of science is probably to join in when you want to" is particularly poignant. She was very open about her lack of confidence and reluctance to speak out in front of her peers. "I get nervous when we have to do speeches in front of the class and we talk about things in class cos I'm not a very confident person."

Beth does not appear to have many strategies for finding the answers to things she doesn't know. When asked what she does when she finds something hard, Beth stated "Well, if I don't know what it is I'll probably just guess it or (sighing) I really don't know." When discussing the way she answered the questions in the pre and post-tests, Beth stated "Well sometimes I didn't understand the question and I had to answer cos the thing how you said um, baking soda or something that if we mixed them together could you get it out or something, and I put no. I just had to make up some things." These responses confirm the earlier analysis that as Beth was unable to explain her correct response to item 12, it was likely to be a guess. In addition, Beth finds predicting difficult. "It seems quite hard to think what's going to happen, cos I've never really done sort of experience like that before." She also comments that she sometimes finds it difficult to remember things. "When I want to remember what I learned from experiments I felt weird cos you know you've got to think back about it so it's quite hard really...Sometimes when you have to remember about everything really it gets um, quite exhausting."

Beth reports to learn better when things are fun. "I think that it is important to have fun so that it makes me learn quicker I think." In contrast, Beth likens being bored to being asleep. She qualified this by indicating that the addition of interest or fun would wake her up. "When you're bored it feels like you're asleep sort of."

Interviewer; You were saying that if there was something fun that would wake you up...And what would happen if you woke up like that?

Beth: Well, I'd have a smile on my face and I'd probably be thinking about like, I don't know.

In summary, at the end of the science unit Beth's overall score as indicated by her pre and post-tests increased by one. This score has been calculated by adding the new items learned, then subtracting those items she mis-learned. It may be argued that some of Beth's continuing misconceptions and her limited in-depth understanding of new concepts are the result of the passive roles she chooses to take, or is forced to take, in both group and whole

class contests. Within the context of the classroom, Beth appears to go for lengthy periods of time without drawing the attention of her peers or the teacher. Her limited social interactions may restrict opportunities for cognitive engagement and to increase her status within the class. Beth is able to clearly articulate that she learns best and remembers things better when she is involved and having fun, however her quiet and compliant manner appears to be taken advantage of in the classroom.

In spite of those factors that limit her full participation, Beth reports to enjoy school, and to be particularly interested in science. Beth also reported that she particularly enjoys reading about science because it's very interesting and that she sometimes conducts her own experiments at home. This may be one way Beth compensates for her lack of opportunities for hands-on experience at school. In her concluding interview comments, Beth articulated three clear goals in relation to compliance and the need to work hard at school. "I want to get a good report at the end of the year. I want to make my mum and dad proud, and I want to get better at things."

Jeff

Jeff took an active role within his own group for 10 minutes of the 12.5 minutes available during the group experimental phase. He spent the balance of the available time engaged in watching other groups' experiments. Jeff's well developed social skills and his generally confident manner enabled him to interact positively and confidently with the teacher and his peers in both whole class and group situations. Jeff appeared to be well accepted by his group which consisted of one girl and three other boys. Despite the excitement of other group members, Jeff demonstrated an active, but systematic and conscientious approach to the activity. Jeff shared his sound understanding of the activity instructions by telling other group members how to measure the ingredients and specifying the correct amounts to use. Jeff demonstrated a willingness to take turns to add ingredients and to offer positive and constructive advice to others. Although Jeff became quite assertive in the way he was giving instructions, he received no negative comments from the group.

Jeff demonstrated his understanding of the need for students to take turns and share resources in a group context. In a post-unit interview about working in groups Jeff stated: "Claire tried to be like the boss of it. I don't really like her trying to be the boss all the time. She doesn't give anybody else much of a turn. It's important that everybody gets a turn so everybody joins in and doesn't get like really bored and stuff." The attitude was evident in the way in which Jeff conducted himself in his own group. Not only could he articulate the rules for effective group work, he also applied them.

As soon as the students were dismissed to start their experiments, Jeff took responsibility for organizing his group's resources. As demonstrated in the following extract, Jeff was aware of the need for accuracy when measuring the ingredients carefully, and he became exasperated at Randal's spontaneous, inaccurate approach to adding the ingredients to the bottle.

Times 74-76

Jeff:	Pour it into here then pour that into there.
Randal:	No way.
J:	A third full remember. It's too far Randal, you need to put it down a wee bit...Oh you're putting all your stuff too high here. A third's there. Stop, stop! Oh, you put too much. Just put a little bit. Try not to spill it.
R:	I'll try not to.
J:	It's a bad promise to make.
S:	Well, hurry up. One third and one third.
J:	Stop, stop.
R:	A little more in. We might get a bigger explosion...that's about a third.
J:	That's more than a third.
R (laughing):	Well, it doesn't really matter.

Jeff did not persist with his attempt to get Randal to be accurate and at this point the boys took their pop-gun outside where Jeff stated: "I now pronounce that we will have a very big explosion."

Jeff was prepared to be assertive within his group when he felt it was his turn to do something, or if another student was wrong. When his group's experiment was initially unsuccessful, Jeff suggested that they needed more baking soda. One of the students in the group asked for a teaspoon to measure the ingredients. Jeff corrected him stating: "A tablesp...I'm doing this because I've put in the least." Another student in the group wanted to tip the baking soda in without measuring it. Once again, Jeff demonstrated his understanding of the activity instructions by insisting on the need to use either a tablespoon or three teaspoons. Jeff had obviously been thinking it would not need another full tablespoon of baking soda as they had already added some to the bottle stating: "A tablespoon's actually quite a lot." Jeff managed to locate additional baking soda before the teacher asked all students to return to the classroom to discuss the reasons why many of the experiments were failing.

When the group went outside Jeff again asserted himself shouting: "I'm doing it Rod. Our one's got so much vinegar in it. We don't have a spoon, Miss H where's a table...we need

a..." Jeff then saw another student with a spoon and shouted "Oh, give it to me, give it to me.". Jeff finally managed to put more baking soda into the bottle. Jeff then instructed the group to "Go." Just before the cork popped out of the bottle Jeff screamed "You put it in at the wrong time." As soon as the cork popped he stated to the teacher "I think this is crazy. What happened here?"

Jeff was heard to compare his own group's successful chemical pop-gun experiment very favourably with those of other groups. "Oh gee, our one's always the champion...That was cool. Our one's the best eh Rod? Our one's way far the best. Hey Rod, our one's by far the best." After watching other groups again for a few minutes Jeff commented on his group's experiment further stating: "That was the highest one yet. We are so much better than anyone else." Once the students had been asked to move inside, Jeff continued to tell other students about his group's successful experiment. "Our one was the only one that did it. Ours was the only one to blow, and boy, did the second one blow!"

When Jeff left his group to watch other groups experimenting with their pop-guns, he interacted with other students in an easy, confident manner. During the 2.5 minutes Jeff spent watching other groups' experiments he took an active role, interacting socially with other students who were in close proximity to him. While several other students were running around in a very excited manner, screaming and laughing in anticipation of explosions, Jeff remained sufficiently composed to make practical suggestions to other groups about how to make their pop-guns explode. When one group's pop-gun did not appear to be working Jeff shouted "You just need a wee bit more. You need another one." "When the cork finally popped out Jeff joined in the excited discussion commenting positively "How explosive!" Jeff moved on to watch another group's experiment. Observing the shaking bottle and in anticipation of the expected explosion Jeff warned the other students to move shouting: "It's going. It's going. Move it. It's going to pop."

Jeff's comments to his group demonstrated his understanding of the concept of saturation, and the need to measure the ingredients correctly. Jeff's understanding of the concepts was also demonstrated by his active participation during the whole class discussion phases of the lesson. Jeff raised his hand to respond to the teacher's question related to saturation. He was not selected. Jeff also raised his hand in response to all three of the teacher's requests for students to demonstrate that they were listening to her instructions.

Jeff verbally interacted with either the teacher or other students during a total of 43 fifteen second intervals throughout the full 49 minutes lesson. This shows that Jeff was socially interactive for approximately 25% of the lesson. An analysis of Jeff's utterances shows that

he made twice as many content related utterances (a total of 29), as non-content related utterances. This may be regarded as an indication of his on task behaviour and general level of task engagement. In addition to the previously cited examples of content-related discussions between his friends Jeff listened to others as demonstrated in the following example:

Time 177 (Jeff is listening to two other students)

Student 1: The gas. Look at the carbon. The carbon's making air bubbles.

Student 2: Put some more vinegar in.

Student 1: No. The carbon's making air bubbles.

It may be concluded that as a result of Jeff's practical application of the instructions and his prominent and active role within the group, that he had listened to the instructions and understood the activity requirements. Although Jeff was excited throughout the group experiment, he maintained sufficient composure to ensure his group successfully completed their assigned activity. As a result, the activity phase of the lesson appeared to be a rewarding and social experience for Jeff.

Jeff's experience of the report writing phase of Lesson Two

As demonstrated in Table 23, of the 4.5 minutes allocated to the report writing activity, Jeff spend 2.5 minutes writing his report and the other 2 minutes listening to the teacher's discussion about making crystals from copper sulphate.

Jeff wrote the following:

- I learnt that you have to put the right amount of ingredients
- That baking soda mixed with vinager is very very powerful
- Stand back.

Analyses of Jeff's concept learning

Jeff's written and oral responses to pre-test and post-test items relevant to the selected concepts

Item 16: A bottle has a mixture of vinegar and baking soda in it and is sealed by a cork. What makes the cork pop out of the bottle?

Written responses

Pre-test: the chemical reaction

Post-test: the pressure from the chemical reaction between the baking soda and vinager

Oral responses in interview

Jeff:	The chemical reaction between the baking soda and the vinegar.
Interviewer:	Right. And what does it do?
J:	The pressure, the pressure from the chemical reaction. So it goes up, up, up and when it like gets to the top, if there's enough, if the cork's put on properly, it'll go pop.
I:	Did you get to do it?
J:	Yeah, our group did it.
I:	What's actually pushing on the cork?
J:	Like it's foamy stuff pushing on the cork...The vinegar didn't go out. It still seemed to go down.

Analysis of all responses to item 16

Jeff demonstrated his partial knowledge of the concept in the pre-test, and a different part of his partial knowledge in the post-test. In the interview, Jeff stated that it was the foamy stuff pushing on the cork. He was unable to name Co2. He was aware of the need for the cork to fit properly but did not qualify why. Jeff's oral response indicated some confusion between physical and chemical reactions by stating that the vinegar didn't go out, but seemed to go down. He could have been referring to the group's first attempt when they saturated the solution. As discussed previously, Jeff had demonstrated his confusion between the concepts of saturation and dissolving. From his responses to item 16, it is considered that this misconception had not been fully corrected. This is further confirmed by his responses to items 12 – 14.

Item 19: This is what happens when you put baking soda into an acid. Fill in the missing name. Acid + carbonate = ----------+ salt + water

Written responses

Pre-test: don't know

Post-test: carbon dioxide

Oral responses in interview

Jeff:	I think I put carbon dioxide in there.
Interviewer:	I wonder how you knew that.
Jeff:	Carbon dioxide comes out when you do a chemical reaction...We talked about that at the start of the unit.

Analysis of all responses to item 19

Jeff's responses would indicate that he knew the correct answer. As demonstrated in item 16 however, he identified the foamy stuff but did not make the links to carbon dioxide. Jeff's understanding of carbon dioxide would need to be explored in more depth to ascertain the true status of his knowledge.

Item 3: Which of these are acids? (There could be more than one)

Chalk

Rain Water

Lemon Juice

Vinegar

Dishwasher liquid

Coca Cola

Written responses

Pre-test: vinegar, dishwasher liquid

Post-test: lemon juice, vinegar, dishwasher liquid, Coca Cola

Oral responses in interview

Jeff:	Lemon juice, vinegar, dishwasher liquid, Coca Cola
Interview:	Coca Cola! I wonder why you are thinking of Coca Cola?
J:	Like it's a really strong thing. And we did this test and it was like a pH, one, two, three, four, five, six.
I:	Oh right, on that scale.
J:	And that got...it was under an acid...we had an indicator and it goes seven colours.
I:	Way back on the pre-test, did you know what an acid was then?
J:	Yeah. I know I put the vinegar and Coca Cola. I might have put lemon juice.
I:	So you know this before the unit you think?
J:	I just knew what those two were. I wasn't sure about the lemon juice.
I:	So where would you have learned way back about vinegar?
J:	Probably when I was in kindy...cause you made volcanoes out of sand and then you (inaudible)...just like in the unit there has to be an acid and a carbonate.
I:	Did you know that way back in kindy?
J:	Well, you didn't actually know if it was an acid or not but you knew it had to have something like different to go with it.

Analysis of all responses to item 3

Jeff identified one acid in the pre-test, and two in the post-test. Jeff learned that lemon juice was an acid during the topic. In common with Beth, he added two incorrect responses in the post-test, Coca Cola and dishwasher liquid. Jeff insisted that Coca Cola was an acid. He mistakenly thought he had also selected it in the pre-test. Jeff justified his choices by referring to the activity the class had done to determine the pH value of substances. "It's (Coke) like a really strong thing. And we did this test and it was like they come out pH, one, two, three, four, five, six...and that got...it was under an acid." Jeff traced the beginnings of understanding that vinegar was an acid back to his experiences at preschool.

Jeff:	I probably learned about it when I was in kindy...cause you made volcanoes out of sand. Just like in the unit there has to be an acid and a carbonate.
Interviewer:	Did you know that way back in kindy?
J:	Well, you didn't actually know if it was an acid or not but you just knew that you needed something different to go with it.

In response to his understanding that dishwasher liquid was an acid, Jeff stated that he wasn't quite sure if it was an acid or not at the beginning of the unit. His confusion may have arisen as a result of the change in terminology. At the start of the study Jeff thought that the teacher had called it dishwasher powder. He appeared to know that in its powdered form it was a carbonate. When the terminology dishwasher liquid was used in the pre and post-tests, Jeff became unsure whether it was an acid or a carbonate.

Jeff:	I wasn't sure about that one because we did dishwasher something else at the very start. And it was a carbonate so we weren't sure.
Interviewer:	Weren't sure about the liquid. I see. I think you might have done dishwashing powder or something did you?
J:	Yeah, I thought that was it.
I:	Have you any idea why it's a carbonate?
J:	No. It's quite a strong carbonate
I:	That's right. It's quite a strong carbonate for a good reason. I was just wondering if you knew, had heard about that.
J:	No.
I:	One of the things dishwashing stuff has to do is get grease, fat off plates. And carbonates are very good for getting fat off. That's actually why they're there. Nobody told you that.
J:	No.

Item 6: What do we call something that will make bubbles if it is added to an acid?

A gas

Carbonate

A powder

Carbon dioxide

I don't know

Written responses

Pre-test: carbonate

Post-test: carbonate

Oral responses in interview

Jeff:	A carbonate.
Interviewer:	What sorts of things do you remember about that from the unit?
J:	It was at the very start when we were putting things together to make them fizz...like we had lots of ingredients. Like we had lemons, oranges, vinegar, baking powder...dishwashing powder and some other things.
I:	Did you get to have a turn in your group or did you just watch?
J:	We all did some, like we used different ones. I remember Rod and me, we did one that we already knew. We just put the vinegar and baking powder in.
I:	Was any of it new for you?
J:	I don't know. Like dishwashing powder, but we only did that to see if it was an acid or a carbonate. And I think we put it with the orange juice, and it fizzed really well.
I:	Was anything a surprise to you with that lot?
J:	Probably the dishwashing powder...Miss H had put it as a... like an acid on the board. And then she put a big question mark next to it so we didn't actually know where it was supposed to go.
I:	Did you try any of the experiments out at home during the topic?
J:	No, well, I went to Randal's house and we were going to do the pop-guns but it was a bit wet.
I:	Not like Jed who shot his sister.
J:	Toby shot Jack. He got him in the eye. He got a big black eye.

Analysis of all responses to item 6

Jeff was able to state the correct answer in both tests. As with his oral response to item 3, Jeff highlighted the dishwashing powder for comment. His group's interest had been drawn to it due to the fact that the teacher had singled it out for special consideration. Based on a student's prediction, the teacher had originally placed dishwashing powder in the acids list. She then placed a large question mark next to it. This had the effect of raising the students' awareness that it may not be an acid and that they needed to experiment to determine the correct answer. Jeff's group complied and as stated by Jeff, "We put it with orange juice I think, and it fizzed really well."

Items 12-14: All related to the irreversible changes that occur as a result of chemical reactions.

Item 12: If we mixed up some baking soda in lemon juice, it would fizz or make bubbles. After it has stopped fizzing, is there any way we could get the baking soda out of the lemon juice?

Item 13: Why do you think that?

Item 14: What do you think happens to the baking soda?

Written responses

Item 12: Pre-test: No

Post-test: No

Item 13: Pre-test: Because the baking soda doesn't evaporate.

Post–test: Because it would go wet.

Item 14: Pre-test: I don't know.

Post-test: It goes into little pieces and separates.

Oral responses in interview

Jeff:	I put no. Like it's just wasted in the reaction. And like the other bits, all gone into the lemon juice. Like you can get it out but it would be like different.
Interviewer:	How did you learn that? What made you think that?
J:	Well, like if you put baking soda, like we were doing one of them. Like, you can still see it at the bottom but it doesn't seem quite the same.
I:	Is that different from mixing salt and water?
J:	Yeah, because like it doesn't come from mixing lemon juice or anythink...Like salt comes from water.

I: I see. If you mix up salt and water, that's just what they call a physical reaction. But if you mix up lemon juice and baking soda, or vinegar and baking soda, that's a chemical reaction. Now can you tell me the difference between the two?

J: Because one's between a carbonate and an acid. And the other one's...is between an acid and a carbonate.

I: If you mix salt and water and evaporate all the water off, the salt's still there. But if you put baking soda in say some vinegar or something, and then you evaporated all the vinegar off, would you find the baking soda still there or not?

J: Yeah, you'd probably still find it there.

Analysis of all responses to items 12-14

Jeff's responses demonstrate his confusion between physical and chemical reactions. Jeff's incorrect pre-test responses indicates he was thinking of dissolving. He justifies his response by stating in pre-test item 13 that baking soda can be extracted because it doesn't evaporate. He is unable to state what happens to it in item 14. Jeff's post-test answer to item 12 indicates his understanding that baking soda cannot be extracted from lemon juice once it has fizzed. Jeff's confusion as to why remains, as indicated by his answers to items 13 and 14. Jeff's confusion is confirmed by his interview responses. In common with Beth, Jeff had been trying to relate his thinking to his understanding of salt and water.

When asked to differentiate between a physical reaction and a chemical reaction, Jeff attempted to respond but gave the partial explanation for a chemical reaction and then simply reversed the two substances for the physical reaction. Jeff still considered that baking soda, when mixed with vinegar could be found in its original form through evaporating the vinegar off. Jeff's misconceptions of the processes of saturation and dissolving were evident in his incorrect response during the whole class discussion phase. Despite conducting the experiments, Jeff did still not understand the difference between evaporation, dissolving, saturation, and the irreversible nature of chemical reactions.

Jeff's written report for the chemical pop-gun and boat tasks

Jeff wrote the following statements in response to the teacher's instruction to "Write two sentences about something else you learned today."

- I learnt that you have to put the right amount of ingredients
- That baking soda mixed with vinegar is very very powerful
- Stand back

Analysis of Jeff's written report

Jeff's first sentence demonstrates his understanding of the need to add the correct ratios of ingredients. As an active participant in his group's experiment, Jeff had experienced first hand, the process of saturation due to the indiscriminate addition of baking soda and vinegar. Jeff was clearly impressed by the force of pressure produced. He had also witnessed some near misses when students stood too close to the ejecting corks, hence his third statement.

Jeff's responses to questions relating to interest, enjoyment, and difficulty

Do you think you'll find this topic on fizzes and chemicals and molecules and atoms very interesting, a little bit interesting, a little bit boring, or very boring?

Pre-test: very interesting

Post-test: very interesting

Interview: Very interesting.

Do you think you'll find this topic very hard to understand, a little bit hard to understand, mostly easy to understand, or very easy to understand?

Pre-test: mostly easy

Post-test: mostly easy

Interview: (not asked)

During this topic how much did you learn? A lot I did not know, some things I did not know, one or two things I did not know, nothing I did not know?

Post-test: I learned a lot I did not know

Interviewer: (not asked)

What was the activity you enjoyed most in this unit?

Post-test: pop-guns

Interview: Pop-guns.

Factors relevant to Jeff's concept learning

At the conclusion of the science unit, Jeff's overall score as indicated by his pre and post-tests increased by 10, representing the third highest score in the class. One student's score increased by 11, with the highest gain being 13 items.

As demonstrated in Tables 21 and 22, Jeff was actively engaged throughout the lesson. Jeff's confidence and positive self-concept enables him to participate actively in whole class and group contexts. Jeff enjoys moderately high status amongst his peers. He is willing to take a

variety of roles and responsibilities and his well developed social skills make him a readily accepted group member. Jeff demonstrates a balanced, sensible approach while retaining a sense of fun when appropriate. This was particularly evident during the group task when Jeff was attempting, without success, to get other group members to measure the ingredients according to the instructions. Jeff reports that it is important for students not to get too excited. "Cos they don't like to work sometimes when they get too excited. Like a lot of people, just like they just to all crazy."

Jeff considers himself to be bright and he enjoys working with his friends who he also considers to be really bright. As a consequence of his confident, out-going manner, Jeff is able to get plenty of first hand experience of tasks. His high level of social interactions, many of which are content related, afford him plenty of opportunities for cognitive engagement with the concepts as he exchanges his own understandings and possible misconceptions with his peers. Jeff had the advantage of being in one of the groups allocated the pop-gun experiment. This experiment was the most effective in terms of giving the correct information required to answer item 16. When making the pop-guns, Jeff was able to experience first hand the effects of saturation and the fizzing as the chemicals reacted. He also reported that his group had all taken turns to sort acids and carbonates into their respective piles.

Jeff reports to enjoy science and to feel happy during science lessons. This is significant as Jeff considers that being happy is the best mood to be in for learning. Jeff reports to be generally happy during the introductory phases of lessons. "Thinking about what's gonna happen, or with the chemicals, or what we're gonna do next."

Jeff made some interesting comments about the relationship between how he feels about a subject and the impact his mood state has on his perception of how easy or difficult a subject might be to learn. Jeff reported to be frustrated and unhappy at being in the second to lowest spelling group.

Interviewer:	So do you do as well in the subjects that you're bored with?
Jeff:	No (laughs), oh sometimes, like I'm in one of the lowest spelling groups but then I've got like one of the best spelling ages.
I:	So do you think that's got anything to do with the way you feel about the subjects?
J:	Mm, it does cos it's easier for you to like do things when you're happy than when you're bored.

Later in the interview Jeff again made reference to his spelling group. "When I was chosen for spelling groups and stuff, I'm frustrated that I'm not in a higher group."

Jeff enjoys making predictions and thinking about what might happen next. At the prediction stage he doesn't care whether he is right or wrong. Jeff has developed strategies to help him learn and remember information.

Interviewer: What do you do to make yourself remember.

Jeff: Try to think about what we've like done.

Jeff demonstrated his ability to recall prior knowledge and to make links to previous relevant experience in his discussion of the reaction between acids and carbonates, from as far back as preschool. He also goes over things a number of times to help him remember them, and reports he probably has to go over things about three times to remember them.

Jeff reported to be fearful of not doing well and guilty if he gives a wrong answer. This may explain why he did not attempt to answer any further questions during the whole class discussion phases of the lesson after giving an incorrect response and being publicly corrected by Elle.

In summary, it is considered that Jeff's interest in science and his positive attitude towards related tasks and activities, particularly those involving hands-on experimentation, motivates him to learn. Jeff considers he learns best when he is enjoying what he is learning about, particularly maths and technology challenges which are compatible with his interest in science. Jeff has developed strategies to assist him to remember information and to focus on content without being distracted by other events. Jeff's well developed social skills, particularly in group contexts, enable him to interact appropriately with his peers and afford him opportunities for cognitive engagement with the concepts. Jeff enjoys relatively high social status and is readily accepted by his peers. This is reflected in his positive self-concept and a belief in his own academic ability. School is a rewarding experience for Jeff.

Elle

Elle took a very active role within her group during the experimental phase. Elle was engaged in her own group's task for 9 minutes of the 12.5 minutes available. She spent the other 3.5 minutes watching another group's experiment. Elle was the only girl in her group, however this did not adversely affect her level of participation in this particular lesson. Within her own group, Elle was observed to give instructions as well as listen to other students. She was confident and assertive when giving the boys instructions about how to conduct the experiment. Elle established her position in the group at the beginning of the activity phase by immediately moving to get her group's equipment for making the pop-gun.

The teacher was with Elle's group at the beginning of the activity phase, pouring the required amount of vinegar into their bottle. Elle quickly picked up the only other ingredient, the baking soda, and retained possession of it thus ensuring her a key role within her group during the experiment. As soon as the teacher had finished pouring into the vinegar bottle, Elle moved her group outside. She immediately tipped the baking soda into the bottle, making no attempt to measure the required amount. One of the students in her group asked Elle if she was going to put it all in to which she responded: "Yeah." Immediately after adding the baking soda the students shouted with excitement about the need to stand back as they waited for the reaction. They had spent a total of 30 seconds making the pop-gun and in their haste had neglected to put the cork into the bottle. It took 30 seconds before one student in the group realised their error and the cork was put into the bottle. The group members were extremely excited, running around the bottle, shouting and screaming to one another comments such as "It's gonna blow, it's gonna blow," "Get ready for the kick, get ready for the kick." Due to the excessive amount of baking soda and subsequent saturation of the solution, Elle's group's initial experiment was unsuccessful. Elle asked Moses to take the cork out of the bottle stating: "We need some more baking soda and more vinegar."

At that point it was obvious to the teacher that the pop-gun experiments were failing due to the indiscriminate way the students were adding the ingredients. The students were called inside to discuss possible reasons why their experiments were not working. The teacher asked the question "Can you tell me why, when we had a few groups with the pop-guns outside, why it didn't work?" Elle was chosen to respond by the teacher and did so as follows:

Elle:	Maybe there wasn't enough baking soda or not enough vinegar.
Teacher:	So are you saying that you could change the mixture of the substance so that when they reacted you could either put a little more vinegar or a little more baking soda and see if that made a difference?
E:	Yeah.
T:	The one that was closest to popping was the one that Jed went back and pushed the cork down even further. All right? When I did it this morning, and you can see how successful it was, when I did it this morning there was a little bit of leakage in the top of the cork but there wasn't around the sides. So it might mean you want to change your cork when you do that one.

After briefly enquiring about the progress on the boats, the teacher allowed the students to resume their experiments. Elle demonstrated her understanding of the activity instructions by

immediately giving other members in her group a number of instructions for conducting the experiment for the second time including repeating her request to Moses to take the cork out of the bottle and stating to the other members of her group "We need more baking soda and more vinegar...Ah, need more baking soda."

When it was obvious the experiment was not going to work for the second time, Elle attempted to measure the baking soda accurately. Caught up in the excitement of the pop-gun experiment, several of the group members began shouting instructions to Elle as she was attempting to measure the baking soda.

Times 112-113

Elle:	We need this.
Student 1:	Baking soda.
Student 2:	Just watch.
Student 3:	Put the cork in.
Student 4:	It's not working.
E:	We need a teaspoon, we need a teaspoon. No, not enough.
Student 1:	Another one, another one.
Student 2:	It's about four of each.
Student 3:	No don't, it's too small. More, more, more.

The four students then all screamed at Elle to hurry. Pressured by her group, Elle grabbed a plastic cup and attempted to measure the required amount of baking soda in it. In spite of the inaccuracy in measuring the ingredients, two to three minutes later the cork popped out of the bottle. By this time several other students, including Jack, had left their own groups to watch Elle's group's experiment. The following extract demonstrates the students' excitement as they anticipated the explosion, and their haphazard approach that contravened the teacher's requests for conducting the experiment safely.

Times 118-128

Elle:	Take the cork off.
Jack:	Don't just loosen it. Take it right out.
Student:	Take it off, no take it off Randal. We need more baking soda.
E:	Take it off you dingbat.
J:	I'm not ripping it off.

(Elle adds more baking soda to the fizzing bottle).

J:	Hey quick, put it in. Hurry, hurry, hurry.
E:	Right push it in.
J:	Shove it in.
E:	(screams) Come on, come on. (laughs) Give it time mate.

S: Shake it up!

At the successful conclusion of her group's experiment, Elle wandered around watching the other groups' experiments. In common with Jeff, Elle was observed to continually interact with other students, laughing at the fizzing bottles, shouting instructions to them and screaming with excitement as one of the bottles exploded.

Elle's socially interactive behaviour, her active participation, and high rate of responding to the teacher's questions were evident throughout the 49 minute lesson. Elle verbally interacted with either the teacher or her peers during a total of 32 fifteen second intervals throughout the 49 minute lesson. This figure shows that Elle was socially interactive in a verbal way for approximately 16% of the lesson. An analysis of Elle's utterances shows that she made 26 content related utterances and only 6 non-content related utterances. This may be regarded as an indication of her on task behaviour and general level of task engagement.

Table 22 shows Elle's high rate of appropriate attending behaviour (presumed listening and presumed watching) in whole class teacher-led discussions. During the lesson Elle was observed to raise her hand in relation to content related questions on 10 occasions. Elle was chosen to respond on 5 of these, in addition to her one call out of a correct answer. This represents a 50% success rate for Elle in engaging with the teacher in content related discussion. With a total of 28 students in the class this could be considered to be a generous number of opportunities for Elle to answer teacher questions or to engage the teacher in dialogue.

Elle's experience of the lesson was positive. She was confident in her own ability to answer the teacher's questions publicly during whole class discussions. Elle's assertiveness ensured she took a leading role in her group. Although Elle understood the activity instructions, due to a number of social factors operating within her group, the way in which Elle carried out the instructions was not always systematic or in accordance with the teacher's stated expectations. Her group's experiment was successful however, and they received public recognition by being selected to demonstrate their experiment to the rest of the class. Having already been able to demonstrate her knowledge publicly on five occasions during the whole class discussions, the opportunity to demonstrate other skills furthered enhanced Elle's status within the class.

Elle's experience of the report writing phase of Lesson Two

Elle spent 2.5 minutes of the available 4.5 minutes report writing phase engaged in writing. Elle raised her hand during two intervals in an attempt to answer the teacher's question

related to saturation and making crystals from copper sulphate. The remaining time was spent fiddling with equipment and talking to her friends.

Elle did not complete the report writing activity, writing only one of the two required sentences about what she had learned as follows:

- When you add the correct amount of baking soda and vinegar, that is when the reaction is at its optimum point.

Analyses of Elle's concept learning

Elle's written and oral responses to pre-test and post-test items relevant to the selected concepts

Item 16: A bottle has a mixture of vinegar and baking soda in it and is sealed by a cork. What makes the cork pop out of the bottle?

Written responses

Pre-test: The pressure of the gas

Post-test: When you mix b.soda and vinegar a gas

Oral responses at interview

Elle:	Probably because the mixture of vinegar and baking soda forms a bead as I said earlier on. They form a big bead and they form a sort of mix. They form a mixture and the...they mix together and form Co2, and the Co2 builds up the pressure and then slowly gets enough pressure to sort of push the cork out. So the cork goes flying. One of them when we did that. Split in half...It went zoom and then it went...the bottle went flying about two centimetres up in the air.
Interviewer:	I like this idea of yours about a bead. Where did you get that idea from? Was it just something that came to you in your mind?
E:	Basically yes. A big bead, with all these chemicals inside it.
I:	And then they push open?
E:	Basically. It's like a caterpillar. A cocoon. So the caterpillar...there's a butterfly coming out of its cocoon, it's sort of like the Co2 sort of nibbling its way out and then pushing its way out and sort of flying away.
I:	Where does the salt come from, do you know?
E:	Maybe the acid

Analysis of all responses to item 19

In the pre-test, Elle renamed the carbonate (baking soda) as the answer. In the post-test, Elle used the correct symbol (Co2). In her oral response there was no evidence that the symbols represented carbon dioxide, however Elle demonstrated her understanding of the concept by her correct use of the symbols in context.

Item 3: Which of these are acids?

Chalk

Rain water

Lemon juice

Vinegar

Dishwasher liquid

Coca Cola

Written responses

Pre-test: vinegar, dishwasher liquid, Coca Cola

Post-test: chalk, lemon juice, dishwasher liquid

Oral responses in interview

Elle:	Lemon juice, dishwasher liquid, and chalk
Interviewer:	And what was it that made you choose those three?
E:	Well, we did a few tests and we put some chalk in vinegar and then stirred it around and it sort of dissolved a bit. If it dissolved we'd know it was an acid and it actually dissolved...and fizzed. So that means it's an acid when a carbonate and an acid...since vinegar is a carbonate and chalk, we found out that was an acid, and mix together and fizz.
I:	Is that something you knew before the unit? How would you have known that?
E:	Sometimes after dinner when mum and dad...when they leave me to put the dishes in the dishwasher, sometimes I have a little mix around with them.

Analysis of all responses to item 3

Elle's responses demonstrate some confusions and misconceptions held about acids and carbonates. In the pre-test she has incorrectly identified dishwasher liquid and Coca cola as acids. In the post-test she has incorrectly identified dishwasher liquid and chalk as acids. Her oral response demonstrates her confusion with the chalk and vinegar where she has reversed them, naming chalk as the acid and vinegar as the carbonate. Elle demonstrates her partial

understanding of the effect of a chemical reaction (the fizz) but does not make the link to Co2 in her oral response. As with Beth and Jeff, Elle uses the term 'dissolves' in relation to chemical reactions.

Item 6: What do we call something that will make bubbles if it is added to an acid?

A gas

Carbonate

A powder

Carbon dioxide

I don't know

Written responses

Pre-test: carbonate, carbon dioxide

Post-test: carbonate

Oral responses in interview

Elle:	It would definitely be a carbonate. Because an acid and a carbonate mixed together, it fizzes, it makes bubbles.
Interviewer:	There were several examples in the experiments you did. Can you remember?
E:	Yes, in the fire extinguisher, the chemical pop-guns, and the boat.

Analysis of all responses to item 6

In her pre-test, Elle ticked two answers. In the post-test she had ticked the correct answer. She was very definite in her response, qualifying her answer by stating the effect of mixing an acid and a carbonate. Elle was able to recall three examples of tasks the class had done that demonstrated the concept.

Written responses to items 12 – 14

Items 12-14: All related to the irreversible changes that occur as a result of chemical reactions.

Item 12: If we mixed up some baking soda in lemon juice, it would fizz or make bubbles. After it has stopped fizzing, is there any way we could get the baking soda out of the lemon juice?

Item 12: Pre-test: No

Post-test: No

Item 13: Why do you think that?

Item 13: Pre-test: I don't know

Post-test: I don't know

Item 14: What do you think happens to the baking soda?

Item 14: Pre-test: Because lemon juice is an acid, when it gets (stopped writing)

Post-test: No attempt made to answer

Oral responses in interview

Elle:	That was quite a tricky one.
Interviewer:	Can you remember what you put?
E:	No you couldn't get it out.
I:	Why couldn't you get it out of the lemon juice?
E:	Because it probably fizzed and made it...made them both a less amount maybe...If you tried to get them out, you couldn't really because they would sort of mix together and then... they're mixed together and so...yeah. They mix together and then form CO2 then it fizzed.
I:	So they'd actually mixed together and changed so you couldn't get them back.
E:	Changed their form.

Analysis of all responses to items 12-14

Elle stated the correct answer to item 12 in both the pre and post-tests. She was unable to state why. In the pre-test, Elle started to explain her answer to item 12 by writing that lemon juice was an acid. She then stopped writing. This could have been due to the fact that she was anxious about keeping up with the other students taking the test. Alternatively she may not have understood the reason. In the post-test she did not attempt to write an answer. Elle's oral response demonstrated an initial misconception that the baking soda could not be extracted due to the fact that the fizzing would have reduced the quantities. After thinking briefly, Elle gave the correct response. With some prompting she further demonstrated her understanding that substances change their form as the result of a chemical reaction.

Elle's written report for the chemical pop-gun and boat tasks.

- When you add the correct amount of baking soda and vinegar, that is when the reaction is at its optimum point.

Analysis of Elle's written report

In her written report, Elle emphasised the importance of mixing the ingredients in the correct ratio, rather than writing about the production of Co2. Elle had participated in the teacher-led discussion on saturation that took place while the students were writing their reports. Although Elle was attentive throughout the lesson, she wrote the most recent information to

be discussed in her report. An alternative explanation might be that because she already understood the concept of Co2 being released, this would not be new information, which was what the students had been instructed to write. Elle summarised her information into one well-structured, complex sentence.

Elle's responses to questions relating to interest, enjoyment and difficulty

Do you think you'll find this topic very interesting, a little bit interesting, a little bit boring, or mostly boring?

Pre-test: very interesting

Post-test: very interesting

Interview: Very interesting.

Do you think this topic will be very hard to understand, a little bit hard, mostly easy, or very easy to understand?

Pre-test: a little bit hard to understand

Post-test: mostly easy

Interview: Mostly easy.

During the topic, how much did you learn? A lot I did not know, some things I did not know, one or two things I did not know, nothing I did not know.

Post-test: I learned a lot I did not know

Interview: Quite a lot that I didn't know

What was the activity you enjoyed the most in this topic?

Post-test: I enjoyed the chemical pop-guns

Interview: Hokey pokey.

Factors relevant to Elle's concept learning

At the conclusion of the science unit, Elle's overall score as indicated by her pre and post-tests increased by 7. Elle's score was shared by three other students and represented the 11^{th} equal highest gains of the 28 students.

In contrast to Beth, Elle enjoys a high profile within the class. Elle's confident, out-going personality enables her to maximise opportunities to participate fully in the life of the classroom. In this particular lesson, Elle happily joined in with the excitement and behaved in a similar manner to the majority of students. Elle's social status may be enhanced as a result of her peers' perception of her as being knowledgeable, as confirmed by the number of times she is selected to respond publicly to the teacher's questions.

Although Elle reports to being marginalized when expected to work with a group of boys, in this lesson Elle's confidence enabled her to assert herself to ensure she accessed the resources and had her share of hands-on experience. In interview, Elle made some interesting comments concerning gender equity stating:

> I'm the only girl in the group so it's quite annoying because there are bossy boys. Basically if they don't let me have a turn I just watch...They think they are better than girls. I think they are just basically girls but they look like boys...The boys are always insulting me.

Elle then described some of the strategies she has for dealing with 'annoying boys' including "giggling if they do something wrong, cause it's them who have done it and not me."

A significant factor in Elle's concept learning is her high level of interest and anticipation in science topics. Elle stated that she is interested most of the time, even when she's not feeling "exactly excited." Elle finds it fun to listen to other people's thoughts. This description of fun may be significant in Elle's learning. Listening to other people's ideas and points of view could be a factor in increasing the number of cognitive engagements Elle has with a concept.

Elle reports to feeling excited at the beginning of a science lesson. Elle enjoys listening to the teacher, thinking about what might be going to happen, and what answers she might give if selected. Elle stated that although making predictions about what is going to happen is the hardest part of science for her, she is good at predicting and doesn't mind if her predictions are wrong. "Doesn't matter if you make a wrong move cause then you can learn." Elle explained that in this particular lesson, she was thinking about what was coming up. As the teacher introduced the next experiment with vinegar and baking soda, she reported to be thinking about being cautious so that she wouldn't put too much in.

Elle appears to have a number of experiences outside of school that assist her understanding of science concepts. Her father is a geologist and Elle has accompanied him on field trips. She had attended a recent school holiday science programme where she carried out similar experiments to those included in the topic.

Elle has developed strategies for helping her to memorise information. She tries to learn things "off by heart" by reading sheets of information several times. Writing things down helps her to remember. She considers she needs to write things down "about five times" before she remembers them. Elle also says things over and over to herself to assist her

learning and retention. As demonstrated by the metaphor used to explain the release of Co2, Elle has a vivid imagination and reports this also helps her to think and visualise things.

From Elle's responses to questions relating to interest and enjoyment, it is obvious that she has a positive attitude towards science as a subject. She anticipated that the topic would be very interesting and confirmed that it was. She reported that she learned "quite a lot" that she didn't know. She stated that time goes fast when doing science experiments, and slow when she is doing something that she doesn't like. Elle reports that she feels bored when waiting with nothing to do, and hearing information she already knows. In common with Jeff, Elle has developed strategies to cope with boredom.

Elle: If you're in a bored mood, if you're bored you don't really learn you just sort of block your ears so you can't hear...basically shut down...basically just ignore things.

Interviewer: What happens if there's supposed to be something important happening. How would you know because you shut down do you stay shut down the whole time?

E: No, only when it gets more interesting...I don't exactly shut down. I just sort of ignore it.

I: Can you give me an example of when that sort of thing might happen?

E: Like the teacher's just putting up the ingredients on the board (talks slower). And then she says now we can get on with making the beer bread (talks animatedly), then it's interesting.

In summary, Elle appears to share many common characteristics with Jeff. Elle has a demonstrated interest in, and a positive approach to science. Her well-developed social skills and confident manner enable her to interact with her peers and the teacher. Her on-task behaviour enables her to maximise opportunities for cognitive engagement with the concepts. She receives a high level of positive teacher attention during whole class and group discussions. This benefits Elle in terms of her peers' perception of her ability and their general acceptance of her as a desirable group member or working partner. Elle has a range of relevant experiences outside of school to draw on in the classroom. She has developed a range of strategies to assist her to learn and retain information. Elle appears to have a positive belief in her own competence. This is perhaps what enables her to take advantage of learning opportunities and to cope with the range of cognitive and social factors which impact the classroom experience for individual students. Like Jeff, school is a rewarding experience for Elle.

Jack

Jack's experience of the activity phase was characterised by his non-compliance with the teacher's instructions, and his domination of resources and of other groups' experiments. Due to his high level of off task behaviour, Jack was considered to be actively engaged with his own group's assigned task for approximately 8% of the available group experimental time, and to actively engage with another group's task for approximately 34% of the time. This represents a total of 42% of the actual time available for the group experimental phase of the lesson. Jack spent only one minute superficially engaged with his own group during the 12.5 minute experimental phase. Like Beth, Jack capitalised on the fact that the teacher had not specifically instructed students to stay in their assigned groups. The only time Jack was observed to comply with any of the instructions was to fill his group's water trough. Ignoring the requests of the two girls in his group to help them with the construction of the boat, Jack left them to carry out the activity on their own while he and his two friends spend the next seven minutes filling, then playing at the trough. While playing with the water, Jack demonstrated assertive behaviour within his group, consistently rejecting one of his group member's attempts to help fill the trough, dictating who would be able to participate and extent of their participation.

While Jack's offer to fill the trough may have been considered to be an acceptable contribution to the group activity initially, Jack used it as an opportunity for avoiding the assigned activity. As demonstrated in the instructional phase, Jack was extremely resistant to doing the boat activity. He had no intention of reading the instructions and playing with the water was Jack's way of not having to undertake the activity. Jack and his friends turned the job of filling the trough into an opportunity to have a race to fill their plastic bottles and tip them into the trough. The way in which the boys turned the task into a playful activity is demonstrated in the following extracts from times 95-99. It should be noted that at time 94 the teacher had asked all students to return to their seats while she discussed possible reasons for the failure of the pop-gun experiments. Ignoring the teacher's request, Jack and his two friends continued to play at the water trough for a further one minute until the teacher issued his group with a firm reprimand to stop and pay attention.

Time 95-99

Student 1:	Hey Jack, let go, let go. Quick let her rip Jack. Put on the Indy!
Student 2:	Quick, keep it going.
S 1:	We can't.
Jack:	Alain, Alain, it's only supposed to be me, Dexter and Jed. Alian, you're not allowed to.
S.1:	I've already got it.

S.2: It didn't work.

S.1: I popped it. Oh, oh.

J: OK, this is the last bottle. OK? You guys go away.

S.1: Put it down there. No, put it in here.

J: You're in port.

At the teacher's reprimand, Jack reluctantly returned to his desk and appeared to listen to the discussion of why the pop-gun experiments were failing. Jack raised his hand three times in response to the teacher's questions but was not selected to respond. Jack's way of dealing with this was to talk to himself as demonstrated in the following extract.

Times 101-102

Teacher: Put your hand up if you can tell me why, when we had a few groups with the chemical pop-guns outside, why it didn't work? Pat?

Pat: You could have had gaps and the air could have got through.

T: Thank you. Jed?

Jack: (talking to himself) Too much of one thing.

Jed: Because the cork wasn't thick enough and on enough and the air got through. The carbon didn't get through to make it pop.

T: Isn't that the same as what Pat said?

Jack: (talking to himself) That's what I said.

At the conclusion of the whole class discussion the teacher asked Jack's group how their experiment was going. Jack responded "We're done. We just need the vinegar and baking powder." The teacher's comments to Jack later in the session show that she was aware that he had not contributed to his group's construction but she chose not to discuss it with Jack at that point. This is understandable as the demands on the teacher's time were considerable at that particular time. As soon as the teacher dismissed the group to continue with their experiment Jack and his friends immediately resumed their water play. Tiring of this after one further minute, Jack made his preference for the pop-gun experiment clear by leaving his own group and joining Elle's group who were making the chemical pop-guns. Although not invited to join the group, Jack spent the next 4.25 minutes actively engaged with the group's experiment.

Jack immediately proceeded to assume an active role within the group by instructing other students what to do in an assertive manner. "Push it down harder. No, don't, don't, don't, don't. Leave it. It's going to blow. The vinegar, it's going to blow any second now. Watch. Bet she'll blow." When it appeared that the bottle was not going to explode, Jack ignored the teacher's instructions about safety and despite protest from other students in the group,

shouted: "I'll stand over it. Shit! It's exploding." Ignoring other students' requests to leave their equipment alone, Jack increased his level of involvement by physically taking over some of the resources and adding ingredients. At one point, ignoring the teacher's instructions, Jack ran up and shook the bottle. He became increasingly excited as the bottle started to shake, announcing to his peers "The gases are making it shake like that." When it became apparent that the bottle was still not going to explode, Jack issued several more instructions to students in Elle's group. "Baking soda, quick, give me some baking soda." He then confused the ingredients shouting: "Carly, Carly, quick, quick, I need some baking powder. Carly, Carly, put some in. Oh here, here, here."

At the end of the experimental phase the teacher called the students inside to watch a demonstration of the boat experiment by the only group to successfully complete the activity. It happened to be the group that Jack had originally been assigned to. Prior to the demonstration the teacher asked one of the girls in Jack's group how much vinegar she had put in the bottle. She then asked the girl whether she would still be able to take the tissue out of the bottle with the baking soda wrapped in it. Jack interjected stating "Yeah, you will." At this point the teacher made it clear to Jack that she knew he had not contributed to the group efforts stating: "Wait, wait. Your group first. That's because you weren't with your group. You were outside. See what reaction your group's going to have when you come over here." The teacher placed the emphasis on the word 'your' to indicate that Jack would see the reaction by watching the demonstration, rather than through his involvement in the experiment.

The fact that Jack had not contributed to his group's effort did not deter him from making several suggestions on how to operate the boat. At one stage Jack even attempted to take over the demonstration shouting, "Hey, I know how to do it. Here. Oh, I'd put more baking powder in that." As Jack attempted to pick the boat up the other student shouted: "It's working, leave it, leave it!" When it appeared that the boat was going to tip over Jack shouted: "It's going to flood over. Push it right up to there. You guys, you've gotta stop. You've gotta stop Dexter. You gotta wait until the fizz gets...Oh stop it! Just put it there and ...it's going to crash, leave it leave it." Jack then stated: "Mission failed.. As with the pop-gun experiment, Jack became impatient and instructed the other student to "Shake it up." When the boat started to propel through the water Jack commented to himself: "Oh it's going really good now. Successful this."

Although Jack did not carry out his own group's assigned task, his comments and suggestions to peers during the demonstration of the boat experiment showed that he understood the relevant concepts. Despite the relatively low percentage of time Jack engaged with the task

overall, and the fact that Jack did not specifically comply with activity instructions for making the chemical pop-guns, he demonstrated his understanding of the requirements through his practical application and related comments as he took over another group's experiment. It may be concluded that Jack's prior experience with the pop-gun activity earlier that day enabled him to take a prominent role within another group and to use his prior knowledge to assert himself with confidence and a degree of authority.

Jack's level of social interaction during the 49 minute lesson was extremely high. An analysis of Jack's utterances shows that he was interacting verbally with either the teacher or his peers during a total of 124 fifteen second intervals. This demonstrates that Jack was socially interactive verbally for a full 31 minutes. Fifty four of his utterances were content related and must be considered to be an indication of his engagement with the topic. In addition, Jack made 70 unrelated utterances indicating that he also spent significant periods of time socially interacting with his peers about matters unrelated to the topic or activity.

Jack raised his hand in an attempt to interact with the teacher or to respond to content related questions on 17 occasions. This is considerably more than the other subjects. In contrast to Elle who was chosen to respond on 5 of the 10 occasions that she raised her hand, Jack was chosen once out of 17 attempts. He did manage to interact with the teacher on four other occasions. Jack was observed to callout during the whole class discussions on 4 occasions. At time 27 he called out an answer. On two other occasions he asked the teacher if his group could do the pop-gun experiment instead of the boat activity. Jack persisted with this request on a further occasion, however the teacher ignored him. The final interaction occurred as a result of the teacher reprimanding Jack and another boy for playing with the bottles in the water trough. When Elle and Jack's very different success rates in engaging the teacher through hand raising are considered, it appears that Jack realises raising his hand frequently results in limited success and that the most effective way for him to interact publicly is to call out.

Jack is observed to be confident in his social interactions with his peers and they do not often challenge him. He has a tendency to ignore a significant number of the teacher's requests for students to stop talking during whole class discussions, as evidenced by Jack's high rate of utterances. Jack is observed to interpret instructions to suit his own interests. This was evident when he made it clear that he did not want to do the boat activity. In spite of the fact that the teacher had declined his request to do the pop-gun experiment first, Jack left his group without seeking their approval or telling them what he was going to do. The teacher reprimanded Jack and another boy for wasting their time but this was insufficient to deter Jack from continuing with his play. Even though the teacher had made it clear that she knew

Jack had not participated in his group's assigned activity, within thirty seconds Jack persisted in asking the teacher when he would have an opportunity to do the pop-gun experiment.

Jack's experience of the report writing phase of Lesson Two

Jack was actively engaged in writing his report for two of the 4.5 minutes available. Jack spent the rest of the time listening to the teacher's discussion about making crystals out of copper sulphate. During this time Jack raised his hand once to answer the teacher's question about how to make crystals but he was not selected to respond.

Jack wrote the following in his report: (own spelling)

- I learnt not to put to much of one thing.
- I learnt that a saturating saulsion is to much of one ingreedeint.

At the conclusion of the report writing phase of the lesson, the teacher asked all students to hand in their science books for marking. Jack did not comply with the teacher's request, choosing instead to place his book in a box on his desk.

Analyses of Jack's concept learning

Jack's written and oral responses to pre-test and post-test items relevant to the selected concepts

Item 16: A bottle has a mixture of vinegar and baking soda in it and is sealed by a cork. What makes the cork pop out of the bottle?

Written responses (own spelling)

Pre-test: The presure of the gases

Post-test: The carbon dioxse

Oral responses in interview

Interviewer:	What makes the cork pop out of the bottle?
Jack:	Carbon dioxide.
I:	The carbon dioxide. Now, you've got a mixture of vinegar and baking soda in there, so how does that make carbon dioxide?
J:	It fizzes and mixes and starts to get pressure on that and blows away out of it.
I:	And did your experiment work the first time?
J:	No.
I:	Why do you think it worked the second time?

J: It's because the first time we kept on adding more baking soda and more baking soda. We didn't care about the vinegar. We should have added more vinegar instead of baking soda.

I: So what would you have done to the vinegar then if you added too much baking soda?

J: It would have got weaker and weaker.

I: Have you made anything like that before? Have you ever done anything like that before?

J: Oh, I might've. I think in Room 5.

Analysis of all responses to item 16

Jack demonstrated his partial knowledge of the concept in both the pre and post-tests. Jack's oral responses demonstrate his understanding of the effects of mixing an acid and a carbonate, and of the concepts of saturation. He was able to state why the experiment had failed the first time, due to the addition of too much baking soda. Jack described the effect of saturation as making the solution "weaker.". It is assumed he was referring to causing a reduction in the pressure.

Item 19: This is what happens when you put baking soda into an acid. Fill in the missing name. Acid + carbonate =..... + salt + water

Written responses

Pre-test: (no answer given)

Post-test: Fizz

Oral responses in interview

Interviewer: So an acid plus a carbonate equals?

Jack: Carbon dioxide

I: What helped you to understand that?

J: I talked with my friends a lot. Cause we were in our groups and we talked a lot about acids and carbonates and all that. And mixing and all that. So that's how I learned a bit more about it.

I: So do you find that's a really good way to help you learn, talking to other people?

J: Yep.

I: Do you think children of your age, when they're in groups and they're asked to discuss things, do you think you stay on task pretty well and talk about what you're supposed to?

J: Yep. Just most of my friends are very brainy. Rod and Jeff, they're quite brainy. Rod is really brainy.

I: Where do you think he gets all his knowledge?

J: Probably news, he might watch that.

I: Do you watch the news?

J: Yep.

Analysis of all responses to item 19

Jack gave no answer in the pre-test. He wrote fizz in the post-test, indicating he could identify the physical manifestation of the reaction. He was unable to identify it as carbon dioxide. In his oral response Jack was able to state the correct answer. He reported to have learned it through discussion with his "brainy" friends and through his experience of mixing ingredients.

Item 3: Which of these are acids?

Chalk

Rain Water

Lemon Juice

Vinegar

Dishwasher liquid

Coca Cola

Written responses

Pre-test: lemon juice, vinegar, dishwasher liquid

Post-test: lemon juice, dishwasher liquid, Coca Cola

Oral responses in interview

Interviewer: What did you choose for acids?

J: Rain water, lemon juice and dishwashing liquid.

I: Is that something you would have known before, or is it something you learned during the study?

J: Probably I think I learned it in the study.

I: Can you remember what you might have done, or what one of the teachers or somebody might have said that would have helped you? What about rain water for example? Did that come up in the study?

J: No. But it's...some rain water has acids in it.

I: Where do you think the acids would have come from?

J: Um, acids would probably come from...I don't know.

I: What about the lemon juice and the dishwasher liquid?

J: The dishwashing liquid we did in the study. It dissolved and all that.

Analysis of all responses to item 3

Jack identified two acids correctly in the pre-test. In the post-test Jack identified one acid correctly, in addition to selecting two incorrect substances. In the interview Jack stated that he had also selected rain water. He justified his response saying that some rain water has acids in it. He was unable to state where the acids in rain water would come from. He justified his selection of dishwasher liquid as an acid on the basis that it had dissolved when they experimented with mixing acids and carbonates during the study. The confusion between dissolving and the irreversible nature of chemical reactions was common to three of the four subjects.

Item 6: What do we call something that will make bubbles if it is added to an acid?

A gas

Carbonate

A powder

Carbon dioxide

Written response

Pre-test: carbon dioxide

Post-test: carbonate

Oral responses in interview

Jack: Carbon dioxide.

Interviewer: How did you learn that?

J: It's because we added carbonates and acids and it...oh is that right? I think it turned into carbon dioxide. No. That's wrong. (pause) Think that's what I put. Carbon dioxide.

I: So, were there any experiments where you could actually see the bubbles of...

J: Yeah. The one when we blew into the um...that one.

I: Oh, through the straw into the lime water. And what were you blowing into that?

J: Air.

Analysis of all responses to item 6

Jack gave the correct responses in the post-test. His oral response indicates some doubt about what he had remembered writing. He then paused while he thought about it further, questioning the correctness of his answer before restating the incorrect response carbon dioxide. He became distracted by his mention of carbon dioxide and appeared to lose sight of the original question.

Items 12-14: All related to the irreversible changes that occur as a result of chemical reactions.

Item 12: If we mixed some baking soda in lemon juice, it would fizz or make bubbles. After it has stopped fizzing, is there any way we could get the baking soda out of the lemon juice?

Item 13: Why do you think that?

Item 14: What do you think happens to the baking soda?

Written responses (own spelling)

Item 12: Pre-test: Yes

Post-test: Yes

Item 13: Pre-test: Put some more in

Post-test: Evapourtor it out of it

Item 14: Pre-test: Probley nothing

Post-test: Fizzis

Analysis of all responses to items 12-14

Jack's pre and post-test responses were both incorrect. His confusion between dissolving, evaporating, and chemical reactions were evident in all of his responses. His simplistic pre-test response to item 13 (put more in) indicates that he had no real understanding of any of the processes. At the end of the unit he still though that baking soda could be extracted from an acid through evaporation. This demonstrates his lack of understanding of the irreversible nature of chemical reactions. In his answer to post-test item 14, Jack was able to state the effect (fizzes) of adding baking soda to an acid. Despite further questioning he was unable to state that it would change its form. Jack also had a misconception about what would be happening to the two substances when they were mixed, stating that they would be "getting weaker". At the end of the discussion Jack still appeared unsure. He considered that the amount of mixing of the substances could determine whether the baking soda could be

extracted. He again stated that you could try to evaporate it out, but didn't really think it could be done.

Oral responses in interview

Interviewer:	After it's stopped fizzing, is there any way we could get the baking soda back out of the lemon juice?
Jack:	Probably not.
I:	Why do you think that?
J:	Because how we were talking about salt before...salt is, it's different to lemon juice. Lemon juice is like a water, and salt's like a mixture.
I:	A mixture. So what would happen then with the baking soda and lemon juice when they combine and fizz? What is actually happening to those two things?
Jack:	They're getting weaker.
Interviewer:	They're getting weaker. Are they changing their form at all?
Jack:	Could be.
Interviewer:	What do you think happens to the baking soda?
Jack:	It would start to make it just go...bubble a bit more.
Interviewer:	And so how would that make it really hard to get it out of the lemon juice?
Jack:	Cause when it's mixed you never know how well it's missed and all that. So you've got to...you could try to get it out but would be very hard...Could try to evaporate it out but I don't think it would.

Jack's written report for the chemical pop-gun and boat tasks

- I learnt not to put too much of one thing.
- I learnt that a saturating solution is too much of one ingredient.

Analysis of Jack's written report

During the report writing phase Jack was happy to engage in a discussion with the teacher about another concept related to saturation. Jack wrote two related statements in his report, indicating that he was writing about what was most recent in his mind. Jack was unable to write any statements relating to his group's allocated boat activity as he has chosen not to participate. The non-specific teacher instructions for writing the reports enabled Jack to write about his experience with saturation while experimenting in his self-elected group.

Jack's responses to questions relating to interest, enjoyment, and difficulty

Do you think you'll find this topic very interesting, a little bit interesting, a little bit boring, or very boring?

Pre-test: a little bit interesting

Post-test: very interesting

Interview: It's better than most topics we've had.

Do you think you'll find this topic very hard to understand, a little bit hard, mostly easy, or very easy to understand?

Pre-test: very hard to understand

Post-test: mostly easy

Interview: Mostly easy.

During this topic, how much did you learn? A lot I did not know, some things I did not know, one or two things I did not know, nothing I did not know?

Post-test: I learned a lot I did not know

Interview: Some things.

What was the activity you enjoyed the most in this topic?

Post-test: chemical pop-guns and sherbet

Interview: Chemical pop-guns and sherbet.

Factors relevant to Jack's concept learning

Analyses of students' pre and post-test results show that Jack made the least gains of any student in the class. Jack's post-test results show that his overall score actually dropped by four points due to the number of items Jack mislearned during the unit. The decrease in Jack's score was the highest in the class. There are several contributing factors that are considered to impact on Jack's learning.

Jack has the confidence to make his own decisions about the extent to which he complies with the teacher's instructions. Some of the decisions he makes, and the behaviour he engages in impact negatively on his general concentration, and are distracting for other students. One major problem for Jack is the fluctuation in his listening skills. Jack reports getting tired of sitting for long periods of time, preferring to be up and doing things. He also prefers talking to writing things down.

While it may be argued that Jack was actively engaged with the content of the lesson for part of the time, Jack's high rate of non-content related talk clearly limited the amount of content-related information he heard or was able to process. In common with Elle, Jack finds value in listening to other people's ideas. "Discussions can be quite a bit helpful so it gets a bit of

theirs into your mind, and you start to think about theirs.. The problem for Jack is sustaining his focus for long enough to fully benefit from whole class discussions.

As stated in his oral response to item 16, Jack knows that he talks to his friends a lot, claiming these discussions help him to learn. This is particularly true when he is talking to his "really brainy friends, Rod and Jeff." In the post-unit interview, Jack reported to find writing boring.

Interviewer:	Were there any parts of the work that you didn't want to do or found boring?
Jack:	Doing all that writing. My writing isn't very good.
I:	What do you mean isn't very good. Do you mean not very good in what you write, or how it looks?
J:	How neat it is...The hardest part about doing science is writing cause it's kind of annoying when you're doing it...I'd like to just say it and sit down and it goes on my page automatically.

Jack's comments raise the question of what constitutes 'good' writing for Jack. Jack clearly equates neatness with 'good.' Jack's perception may well be the result of his experience over the years of having had his work judged on the standard of its presentation, rather than on the content.

In common with Elle, at the beginning of a science lesson Jack reported to be thinking about what might happen. Jack doesn't mind making predictions and doesn't worry if his predictions are not correct.

Jack:	Some of my predictions are usually right and usually wrong, in between.
Interviewer:	Does it bother you if you make a wrong prediction?
J:	No, it helps you learn. When you make a mistake you try to practise it more and it makes you learn.

Jack is able to articulate the rules for working effectively in a group context but does not apply them. He left the two girls in his group to construct the boat while he pursued his own interests. He then proceeded to dominate another group's resources and take over the construction of their pop-gun. While Jack's behaviour could be considered to be irritating to other students, most appeared to tolerate it. The exception was if there was another confident or dominant student who was prepared to stand up to Jack, or challenge him.

Jack's vocal manner ensures him a high profile in the classroom. He enjoys being the center of attention as evidenced by the pleasure he derived from the teacher telling the class about the unsafe incident that occurred as a result of his unauthorized experimenting with the pop-

gun task that morning. Rather than feeling embarrassed, Jack put on a display of bravado, laughing and telling his friends that it didn't hurt. Jack displayed a similar attitude with the pop-guns outside. Disregarding the teacher's warnings to conduct the task safely, Jack ran up and shook the bottle when it was fizzing. He then stood over it waiting for the cork to eject.

Jack has developed some strategies for learning and remembering information. He reports the need to practise things by writing them down several times and by saying things over and over. Reading something several times is another strategy Jack uses to remember things. In contrast to several other subjects in the study stated who they would need to read or write something four to five times on average in order to remember it, Jack considers that he would need to write or read something "about twenty five to fifty times."

In summary, Jack has a positive attitude to science. His dominant personality and confident manner ensure him ample opportunities for participation. The extent of Jack's cognitive engagement with concepts is considered to be compromised by his high level of non-content related verbal interactions with his peers, his limited concentration span, and his non-compliance with teacher instructions. In this particular lesson Jack was clearly distracted by the excitement and elements of risk inherent in the pop-gun task. When asked what the real highlights of the unit were for him, Jack replied "Making big explosions." Anything else appeared to be secondary.

Teacher management of the activity phase of Lesson Two

In this section, an analysis of the teacher's management of the activity phase of Lesson Two is presented in relation to the following:

- Management of resources;
- Management of student behaviour;
- Monitoring of student compliance with instructions for the boat activity;
- Monitoring of student compliance with instructions for the pop-gun activity;
- Use of questioning during whole class discussions of related concepts;
- Management of the report writing phase.

Management of resources

The majority of the teacher's time during the activity phase of the lesson was spent managing the resources for the two activities. There were a number of problems in relation to the unavailability of sufficient resources for the groups to carry out their respective activities. One of the main reasons was that although the teacher expected the students to stay in their allocated group, this expectation was not explicitly stated. A number of students took advantage of the situation leaving their allocated groups to watch other groups or to join in

with another preferred group. The changing composition of the groups throughout the experimental phase of the lesson resulted in a disproportionate number of students being involved in the pop-gun task. This put an additional strain on resources and also increased the work load of those students who were left to complete the boat activity for their group. Although the teacher was aware that some students were joining other groups, no attempt was made to send students back to their original groups as the teacher was too involved in trying to manage a large number of excited students.

While it had been specified that students were to use teaspoons or tablespoons to measure the required amounts of baking soda, there were insufficient spoons readily available which resulted in students tipping random amounts into their bottles. The same applied to the vinegar. Although the teacher initially measured the required amounts into some groups' bottles, as the pressure on her time increased she was unable to retain control of the vinegar and students took it outside and began to pour their own. Due to the inaccuracy of their measuring, and the fact that more students made pop-guns than were originally allocated, the supply of vinegar ran out. There was also a problem with students not being able to locate corks that would fit their bottles correctly. This contributed to the failure of some of the groups' experiments. Some of the bottles to be used for the boat activity were found to be too brittle for the students to be able to cut the required hole in without the bottle splitting. This caused problems with leakage as the blue tack was ineffective in covering the splits, leading to the failure of two of the groups' boats. In addition, one of the water troughs allocated to the groups making the boats was found to have a leak in it. As the troughs were inside the classroom, this caused additional management problems for the teacher as the trough had to be carried outside to be emptied and the water cleaned off the floor.

The areas used by students to conduct their experiments caused some management problems for the teacher. The groups making the boats were assigned workspaces inside the classroom. They were required to fill their water troughs with water from the sink at the back of the room. Due to their excitement and the fact that Jack and his friends were monopolising the area for their water play, the floor area near the door to the classroom became wet and slippery.

Monitoring of student behaviour

Effective teacher monitoring of the students' interpretation and compliance with activity instructions was severely limited due to the way in which the activities were assigned and the wide area over which the groups were spread. The three groups working on the pop-guns were located outside. As it had started to rain lightly, the students were asked to mix the ingredients for the pop-guns on the veranda and then take their bottles onto the tennis court

area immediately in front of the classroom. As the rain stopped and the numbers of students involved in making the pop-guns increased, some of the groups located themselves on the netball courts, several metres away from the designated area. This made it even more difficult to locate resources. In addition, it was impossible for many students to hear the teacher's instructions and more time consuming for the teacher to move between the groups.

Management of student behaviour was a constant issue for the teacher during the activity phase. Between the start of the activity phase at time 74 and the start of the report writing phase at time 180 (a total of 104 intervals), the teacher issued 36 reprimands or requests for students to stop inappropriate behaviour, or to listen and pay attention. As demonstrated in Table 20, the teacher spent a total of 6.5 minutes of the time allocated for the activity phase waiting for students to settle sufficiently to hear further instructions and discussion of the related concepts.

Although the teacher had explicitly stated some expectations of performance, particularly in relation to conducting the pop-gun experiment safely, the problems with monitoring the students effectively resulted in the teacher not really knowing the extent to which the expectations had been met. Observations of students' behaviour and their approach to the activities showed that a number of students took advantage of the situation regarding the group experimental time as an opportunity to have as much fun as possible. As the teacher had stated that the activities were designed to have fun, the students were not contravening any instructions by doing so.

The following extract demonstrates the reality of one teacher attempting to manage six groups of students as they began their activities. Within the space of 1.5 minutes the teacher had moved between three different groups, one located outside and two inside.

Time 74. Teacher at Elle's Group

Teacher:	Would you take that cork off please. Wait.
Moses:	Is this the one you used?
T:	No. Let's see how much you've got in. Put it down!

Time 75-76. Teacher at Jack's Group

Student:	Miss H, do we fill it up with water for the boats?
T:	Yes. Just start off with one for a start. Just use something like...just use a container.
S:	Is this too thin?
T:	Does it go right through?

S: Yeah.

T: Yeah. I'd try a slightly fatter one. All right. Where's that other bottle we need to fill up? I see, you're doing your damage first are you?

Time 77. Teacher moves to another group outside.

Student: Is this safe?

Teacher: Have you got it?

S: Yeah.

T: D, where is your group?

As no roles had been assigned within groups, there was no explicitly stated individual accountability for students to take responsibility for carrying out the activities as instructed. The demonstrated success of the experiments could be considered to be an implicit accountability measure.

Monitoring of student compliance with instructions for chemical pop-gun activity

The teacher had been very specific with her instructions about the need for students to conduct the pop-gun experiment safely. Due to the fact that over half of the class was outside, it was difficult for the teacher to monitor whether all students were complying with the instructions. Students largely disregarded the instructions for the correct amount of ingredients for the pop-gun activity as written on the board. Due to the fact that the teacher had explicitly stated the expected outcome of the experiment during the instructional phase of the session, most students already knew what to expect if their experiment was successful. This effectively negated any real experimentation on the part of the students.

A number of students were observed to place themselves in situations of risk through non-compliance with instructions, standing too close to the bottles once the reactions had started, running up and adjusting the corks, or shaking the bottles in an attempt to speed up the reaction process. During the same interval Jack was repeatedly shouting at the students in Elle's group to shake their bottle up to speed the reaction.

The following extract demonstrates how the students in Jeff's group had contravened the teacher's instructions to stand well back from the exploding bottles.

Time 131

Jeff: Did you see how high that last one went? The last one was highest.

Rod: The last one was hitting my face.

Because of the excitement created by the pop-gun activity, the students appeared to take a very superficial approach to the experiment, eager to achieve the end result – an explosion. This superficial approach could not be reversed by the teacher who needed to spend the majority of the time monitoring the physical management of the activities rather than being able to interact with students about the concepts involved.

Monitoring of student compliance with instructions for the boat activity

Teacher monitoring of the way in which students were managing the boat activity was largely limited to telling students where they could locate resources and how to remedy problems with leakage. As with the pop-guns, the teacher's monitoring of student activity in relation to their understanding of the relevant science concepts that the boat activity was designed to promote, was minimal. The majority of student – teacher interactions concerned the physical management of the construction of the boats and the location of resources.

The teacher was clearly distracted by the students who were making the pop-guns. As a consequence of the continual disruptions and the need to monitor the behaviour of the groups outside, less than one minute of the teacher's time was spent assisting the students who were making the boats.

Some groups of students largely disregarded the written instructions for constructing the boats. In contrast, one group of students appeared to follow the written instructions systematically. It is of interest to note that this was the only group to successfully complete the activity. In Jack's group, most of the intricate construction components were undertaken by the two girls in the group.

The following extract demonstrates the pressure on the teacher as she attempted to help one of the groups working on the boat activity. One student asked how much baking soda they would need. The teacher was too busy with an aspect relating to the construction of the boat to answer the question. The teacher had just returned from checking the groups working outside.

Teacher:	It's probably for your boat.
Student 1:	Do we need baking soda? How much?
T:	There's a little bit of bake...could I just borrow that for a moment please?
S 1:	How much do we need?
Student 2:	OK. We're ready to take the cork out.
T:	Could you just hold that open for me please?
S 2:	We need a tissue.
T:	The tissues are on the desk at the front. You saw that!

S 1: We need baking soda.

S 2: Miss H, our cork's...

S 1: Can't put it in there, too much. Can't pull the cork out.

S 2: So we've wasted it.

T: You can't if you can't get the cork out can you?

Three minutes later the teacher showed signs of increasing pressure and exasperation as evidenced in her conversation with another group working on their boat.

Times 125-128

Student 1: The bottle's empty Miss H.

Teacher: Well, if the bottle's empty it might be empty! I can't get that one (cork) out.

Student 2: Our boat is leaking.

T: Your boat's leaking?

S.2: Yeah. Here.

T: Oh the hole's leaking underneath.

S.2: Can you please get that off?

T: Probably not. Who managed to bung it in that hard?

S.2: Me.

T: Oh God! That one's too late. There's always one! There we go.

Teacher questioning and use of whole class discussion during the activity phase

There were two discussion phases within the activity phase. The first brief discussion was implemented by the teacher five minutes after the start of the activity phase when it was obvious that most groups' experiments were failing. The interruption to the experiments and the teacher's request for students to return to the classroom met with many groans and it took the teacher two minutes to gain the attention of the class. Once settled, the teacher spent 1.5 minutes discussing the possible reasons for the failure of the experiments and to suggest improvements. It also appeared to be used as a management strategy to subdue a number of very excited students and to restate the need to conduct the experiments safely.

During this discussion phase the teacher asked for reasons why the pop-guns didn't work. Responses included the thickness of the cork, insufficient vinegar or baking soda, and too much vinegar. The teacher did not provide the students with specific directions but made the following suggestions for them to try.

> So are you saying that you could change the mixture of the substance so that when they reacted you could either put a little bit more vinegar or a little bit more baking soda an see if that made a difference? When I did it this morning there was a little bit

of leakage around the top of the cork but there wasn't around the sides. So it might mean that you want to change your cork when you do that one.

The second whole class discussion phase occurred 7.5 minutes later and lasted 5.5 minutes. Of this, 3.5 minutes were spent discussing the pop-guns and saturation, with the remaining 2 minutes spent discussing the boat experiment. During the discussion of the pop-guns the teacher asked 11 specific content-related questions. Examples of the questions and the teacher's response to students include the following:

Teacher:	The people making the pop-guns, after the first time, what did you do differently that made them blow the second time?
Elle:	The amount of chemicals that you put in it.
T:	The amount of...what did you change?
E:	The baking soda.
T:	Thank you.
T:	Anybody try anything different or know something else that changed?
Student 1:	I put vinegar in, and that bottle went fizzing up so fast?
Student 2:	The Asian cork.
Student 3:	The Asian cork.
T:	(ignoring the comments) Some people were just putting a lot more baking soda in. Why wasn't that really effective? It worked for a little bit of time but why wasn't it really effective in the end?
Jed:	It wasn't mixing with (inaudible). It was too heavy.
T:	What do you call it if you've got one substance and you're starting to put a lot of it in, and then suddenly it doesn't want any more of it? It's called doing something to a solution.
Student:	Ruining it.
Jeff:	Diluting it.
T:	Not quite. No, it's the opposite.
Elle:	Saturating.
T:	All right. It's called saturating the solution. What does that mean for the chemical reaction then?

The teacher then drew a diagram on the whiteboard to represent optimum point explaining it as follows:

> If I was graphing this and I had a graph like this, and if the point, at the top point here, was the best point for firing, or the optimum point...the recipe that you've got there, the third of a bottle of vinegar...and perhaps we could have put a wee bit more

vinegar in if we had it and the tablespoon of baking soda...that was the optimum amount for your chemical pop-gun to blow. Anything less than that in either the baking soda or the vinegar, it wouldn't have worked as well.

The contrast to the above concept-related questions, when discussing the boats the teacher asked three general questions related to their construction as demonstrated in the following examples.

Teacher:	Lorraine's group. How did the boat go?
Lorraine:	It had a leak in the hole and all the stuff came out and it was bubbling through the straw and it wasn't moving.
T:	So did your boat move when it went into the water?
L:	Only a very little because all the, all the vinegar was coming out through the hole in the back (inaudible) plugged.
T:	Plugged with what? What would you suggest?
L:	Blue tack.
T:	Right. Did you not use any blue tack?
L:	We used blue tack but um, down the bottom.
T:	When you made the hole in the plastic...who else did the boat please? (to girl) You're still doing it. OK. When you found you put the hole in, my concern was that if once you put the hole in it was just going to split. Did it split or did you manage to get a fairly round hole in it?
G:	It was more like a split.

The teacher did not continue the discussion to explain the possible effects of the splits and leaks on the outcome of the experiment. The students were then asked to watch a demonstration of the one successful boat experiment. The demonstration lasted for 30 seconds and the teacher's only comment during this time was "It's not too bad though. It's fizzing away." There was no further discussion and the students were then instructed to write their reports.

It is of interest to note the students' comments about the slow Asian cork. This was the second time during the lesson that such comments had been made. In both cases the teacher chose to ignore them. The decile ten school was located in close proximity to a high value residential area commonly referred to as 'Asian-head,' due to the large number of wealthy Asian families living there. There have been occasional reports in the media about the driving skills of some Asian drivers as they adjust to local conditions, and it is not unusual to hear members of the public speaking in derogatory terms about Asian drivers. The school had several Asian students on the roll and it was not uncommon to hear the other students making

such comments. This is likely to be the result of adult conversations they had overheard – particularly in relation to the slow speed that some Asian drivers are observed to travel at. While there was no overt discrimination observed between the students, it would be of interest to interview the two groups of students to explore the effects that such comments may have on minority group students in the school context.

Consistent with the instructional phase, there was a disproportionate amount of time spent discussing the two activities. The majority of the teacher's time and focus in terms of the content of the activities was on the chemical pop-guns.

Teacher management of the report writing phase of Lesson Two

The instructions for writing the reports were very brief with the teacher stating: "What I want you to do please, is to write down at least two sentences of something else you've learned today...Just put the date please." The teacher then announced that if students wanted to make the pop-guns the following day they would have to provide their own vinegar. She concluded with the following warning "But please, just another safety thing. Don't go home and get into mum or dad's vinegar and baking soda before they come home. Wait. All right?"

At the beginning of the report writing phase it was obvious that some students were having difficulty recalling something they had learned. One student stated: "I've got one. I can't think of two." Another stated: "I can't even think of one." The teacher then referred them to the graph on the whiteboard showing the concept of optimum point. While students were starting to write their reports, the teacher followed up the discussion on saturation. At time 188, the teacher re-introduced the concept by asking for a definition of saturation. She then asked what happens to the reaction once you start saturating it and whether it speeds up or slows down. Jed responded "Slows down." Reinforcing his response the teacher then began a discussion of making copper sulphate crystals as a specific example of when saturation might occur. This was the first mention of copper sulphate in relation to the concept and was not related to any post-test item. Two students in particular engaged in the discussion with the teacher. While the discussion was relevant to the concept of saturation, it could have been distracting for those students who were trying to focus on their reports, especially with the limited time available to complete them. The session concluded with the teacher asking all students to hand in their topic books for marking. Not all students complied with her requests.

Summary

In conclusion, the analyses of the activity phases of the two lessons presented in this chapter demonstrate the unique and individual ways that the students participated in classroom

activities, and the differences in the way the teacher managed the activity phases. It is obvious that the teacher had deliberately planned the activities for both lessons, and expected that they would be able to be carried out according to her instructions by all students (with the exception of students for whom English is a second language). The teacher had also expected that she would be able to manage the activities effectively during the activity phases and to monitor student understanding of the concepts selected to be taught. As demonstrated however, due to a wide range of contributing factors there was a considerable variation in the extent to which individual students complied with the teachers instructions and succeeded in carrying out the activities. In Lesson Two in particular, the extent to which the teacher was able to monitor student compliance with the activity instructions, and to engage in concept-related discussions, was severely compromised by the management and resource issues she was confronted with.

Based on the evidence presented, it is argued that the way in which activities are structured and monitored, and the opportunities that are afforded for participation significantly influence the way in which individual students experience the social and academic life of the classroom. The data suggests that it is clearly unrealistic to expect one teacher to be able to manage a class of thirty individual students in such a way that will ensure they all experience activities in the same way. In the same way, it is not possible for one teacher to fully monitor an individual student's concept understanding in a group or whole class context.

On the basis of the analyses presented so far, it would not be difficult to compile a list of principles relating to effective task design and management. It is thought however, that this would only provide part of the picture. Fundamental to increasing our understanding of the complexity of the teaching-learning relationship, is the need to discuss the students' and teacher's perceptions and experiences of teaching and learning. By taking into account the lived reality of the classroom for both students and teacher, we can add to what we are otherwise limited to, which is usually what we as teachers are able to observe and record.

An important aspect of my own research was the in-depth interviews I conducted with the teachers in the eight studies. In the next chapter I present and discuss the content of the interviews conducted with the teacher of the two lessons selected for analysis.

CHAPTER 7

THE TEACHER

In the teaching / learning relationship, the teacher is considered to be the central authority, having the primary responsibility for determining the quality of the students' classroom learning experiences. Quality teaching is defined as "pedagogical practices that facilitate for heterogeneous groups of students their access to information, and ability to engage in classroom activities and tasks in ways that facilitate learning related to curriculum goals" (Alton-Lee & Nuthall, 1998, cited in Alton-Lee, 2003, p1). Alton-Lee states:

> Quality teaching has a key role because from within the education system, and in partnership with parents and caregivers, it is the most influential point of leverage on student outcomes. Quality teaching influences the quality of student participation, involvement and achievement (including social outcomes) (p. 2).

In this chapter, a summary of the interviews conducted with the teacher of the "Kitchen Chemistry" and "Learning about the Aztecs" units is presented. The teacher was one of four teachers who participated in the Project on Learning studies. These teachers demonstrated their considerable commitment to supporting research into teaching and learning by inviting the research team into their respective classrooms. In addition to allowing us to observe and record their practice, they also agreed to share their thoughts on a wide range of educational issues in a series of interviews conducted at the end of each study.

It was considered important to include this interview data in order to illuminate aspects of the teacher's practice that I wanted to explore more fully to better understand the relationship between the teacher's stated philosophy and practice. The teacher is herein referred to as 'T'.

Based on the interview data, the key issues to be discussed in this section include:

- a brief overview of T's career, including biographical details, T's initial attraction to teaching, and her future career aspirations;
- T's philosophy of teaching and the theoretical principles she subscribes to;
- T's preferred teaching contexts, including subject area strengths;
- T's management of the learning context, including issues related to planning of units and learning activities;
- T's use of adaptation, modification, and reflection to effect required changes during lessons and activities;
- T's expectation of student performance and the encouragement of learner independence;
- evaluation of student progress throughout the units;

- constraints that T feels impact the implementation of best practice as articulated in T's philosophy of teaching.

Career overview

At the time of interview, T had completed approximately 13 years of teaching. Her experience has included teaching at various class levels and in schools with a range of decile ratings. T spent one year teaching in positions overseas. T currently holds the position of Deputy Principal at a high-decile urban contributing school. In addition to normal teaching duties, T has specific responsibility for curriculum within the school. T had held this position for one year at the time of interview. T did not have a specific interest in working with learners of high ability prior to being appointed to teach in the high-ability streamed Year 5/6 classroom. The class was established at the request of a group of parents who considered that their children should be given the opportunity for extension. T has subsequently developed an interest in working with learners classified as being of high ability.

T holds the following qualifications: The New Zealand Trained Teacher's Certificate and the National Diploma in Educational Management. T is currently studying towards a Master of Education Degree. T's future career aspirations include gaining a principal's position.

Philosophy of teaching

T's philosophy of teaching incorporates a number of beliefs and principles that are compatible with a social constructivist approach to teaching and learning. The importance of the following aspects of teaching and learning were emphasised by T during the three interviews.

Learners as active participants in the learning process

T considers that students should be active participants in the learning process and that the provision of a range of activities and opportunities for experimentation is fundamental to ensuring an interesting and stimulating learning environment. "I have the philosophy that kids learn through doing rather than me being up the front. When planning I try to get as many hands on activities as possible."

Students learning from each other

T's comment in relation to how students learn demonstrate her awareness of the ways students can learn from each other. Discussing the Aztec unit, T had expressed concerns that the unit was "slow to take off." Many of the activities in the first few days had been individual with students working on mapping activities and individual worksheets. Interest in the unit only began to develop when the students started work on their research projects, and in particular once they were allowed to work collaboratively. There is a tension between T's

insistence that the students worked individually when designing their research questions and the following comment where she acknowledges the benefits of students sharing their ideas and understandings. "That's particularly interesting when you get a few kids feeding off each other in terms of the thinking.... You get that an awful lot in here."

Learners as individuals and planning to meet individual needs

T made several references to the need to be aware of the needs of individual students, citing several specific examples that demonstrated her knowledge of the students in her class.

> I'm very aware of catering for everyone's needs. It's difficult to motivate R as well at the top end. And that's why I brought in A as the chemistry specialist. Because R is in the top 1% of kids in New Zealand for his age. It's really hard to motivate him and to know whether or not he's actually interested in what he's doing....You take Elle. Give her a choice and she flits all over the place. She might be doing something totally unrelated to what we're doing. But she's got it all in...she's listening to everything you've said. She's got quite a deep level of thinking but if you say OK, show me on paper what you've done, she might not have achieved much at all.

The significance of prior knowledge

T acknowledges the need for students to have some prior knowledge or experience of a topic or concept in order to make links to new concepts and knowledge. In discussing her planning of the Kitchen Chemistry unit, T selected activities that would build on the students' previous experiences and further develop their concept understanding. T did not apply the same principles when selecting the Aztec topic. From the pre-test results of the Aztec unit, it was obvious that not one of the students had any prior knowledge of the topic. Ned, one of the subjects in the study, had never heard the word Aztecs before and thought it might have something to do with technology (Aztechs). T observed the students to be generally disinterested in the topic for the first few sessions, causing her to doubt her choice of topic. T was aware that choosing such a topic was inconsistent with 'good teaching practice' but it was still manageable as a topic as she was working with high ability students.

Teacher: I was a bit worried at the start (of the Aztec unit) with the lack of enthusiasm and things right at the beginning. I thought maybe I'd chosen the wrong topic. Just that they didn't know anything about the topic at all. And they didn't think it would appeal to them and you know the history and that sort of thing.

Interviewer: I was interested that Ned had never heard the word Aztec before, so they starting right from the word go weren't they?

T: Which is probably against everything that we should probably be teaching. Normally you hang it on some sort of prior knowledge. But starting from scratch...with those kids you can get away with it, having a brighter class.

I: There seemed to be a certain level of knowledge that they needed to have with a topic like that that they knew nothing about. And once they reached that point they were off weren't they?

T: Then they were off. Because I guess they can hang their knowledge on what they've just gained.

Importance of student interest

Teacher acknowledges the importance of student interest in teaching and learning.

I: What would your theory be about how student interest affects the learning process?

T: Hugely. If the kids are interested then they do remember more, and they certainly show a greater knowledge. If there's low interest, then why? And if the kids aren't interested at all I'd more likely say well what's the problem? Is it the topic, is it the curriculum area. You know, try and get some sort of a grip as to why. More often than not it's because of some experience in the past. It might have been taught to them in the past. They might have already covered it. They see it as going over the same old ground. It was a bit boring last time.... Mum and Dad said that's boring, so the influence of other adults. Sometimes it could be a skill they're not good at compared with the other kids, so it's a competitive thing.... The kids that are really highly interested I've found have parents and resources at home that they go home and say hey, I'm doing this or that and the next day they'll come with some new found knowledge. For example Elle, she continually does this. I think this is just her level of motivation, you know, that is her self motivation of learning and generating knowledge.

T gauges student interest by their interactions and the number of questions they ask.

I: How do you get feedback on whether the children are interested? What are the indicators that you as a teacher register to yourself to confirm that the children are interested?

T: For me it's their interactions with others. The talk between other kids, the questions – if they're questioning. If I can get alongside...ask how are things going? The interactions that you have in that way, they're the most valuable because you're giving the feedback to the kids.

Incorporating student choice in learning

T believes in incorporating learner choice in a variety of ways. Students are given a choice of reading activities and the order in which they complete set tasks. Students are allowed to choose how to present their research projects within limits. T commented that there are occasions when she considers it preferable to offer students limited choice as a way of supporting indecisive students and to ensure the availability of adequate resources. In the Aztec unit, students were required to select one of six aspects of Aztec life nominated by T to base their independent research on. T explained her provision of limited choice.

> You still have the same kids who are disorganised and can't make the initial decisions...If I'd said to them OK, choose any aspect of Aztec life you like, then it would have been more difficult for those children who can't make decisions. But by giving them the six key words that we used, you have to choose one of the six, then it's not quite so difficult...And I had a look beforehand and made sure that the (resource) books related to the topics. So you're setting them up to succeed anyway, rather than setting them up and saying, I know you're going to fail, by not having the parts there.

Development of learner independence and responsibility

One of T's primary goals for her students is to develop their independence and willingness to accept increasing responsibility for their own learning. T was particularly pleased, and somewhat surprised at how independently the students were working on their Aztec research projects, particularly in the last few sessions before they were required to present their research to the whole class. In discussing the development of learner independence and students' willingness to take greater responsibility for their learning, T commented "I think they've taken on a bit more responsibility...I was amazed you know, I looked around the room at one point and thought I don't even need to be in the room." T mentioned a range of strategies that are helpful in developing learner independence, for example the use of deadlines and clearly stated expectations.

Value of classroom interaction

T recognises the value of open interactions between teacher and students and between the students themselves. T commented that high ability learners are often not strong in oral skills and therefore needed encouragement to express their opinions openly, and to be courteous, responsive listeners.

Research process where students set own questions

T is a strong advocate of the use of the research process with her students. T expressed the tension she feels between the difference in her understanding of how to use the research process most effectively and that of some of the parents of students in her class. Consistent with her belief that students learn by linking new knowledge to existing knowledge and experience, T considers it is preferable for students to conduct research on a topic they already have some prior knowledge of. In contrast, she feels some parents consider that research should involve the study of something that is completely new to the student. "You know our parents still see like research, that you have to always choose something that you don't know anything about...Maybe that's our education of parents too, because now we have changed." T's comment suggests that while teachers' understanding of the learning process may have changed in line with current learning theory, the perceptions of many parents are based on their own experience of research where they had to research an entirely new topic. T indicated the need to conduct parent education in order to develop a mutual understanding of the research process.

Encouraging a deep approach to thinking and learning

As evidenced by T's focus on deep and surface levels of thinking during the instructional phase of the Aztec question writing lesson, T believes it is important to encourage students to take a deep rather than surface approach to thinking and learning, "I've spoken to the kids quite a lot about the higher level of thinking, the deeper thinking rather than just on the surface, what you think."

Interest in teaching high ability learners

T has developed a particular interest in working with students who are considered to be of high ability. She was specifically employed to teach the Year 5 and 6 ability streamed class. T regards her work with high ability students to be both challenging and rewarding. T feels the responsibility of having to constantly motivate and challenge very able students. Conversely, the fact that she doesn't have to spend time on teaching basic reading and group skills gives her time to spend on other aspects of teaching. T used group work extensively in her programme. I asked whether she had done a lot of work with the students in terms of group work and group roles, to which she responded:

> Not a huge amount, because they're able kids you don't really need to...they have fairly well established cooperative skills. They really do as children, as a group, I selected groups at random down the roll. I didn't select them in any particular way other than keep... there were three or four boys I wanted to make sure weren't in the same group. C's got a very dominating nature. I found that particularly hard because the others wouldn't listen to her. But that's her and she's got to learn about that. So I haven't done a lot about group roles this year. It's more, you're part of a group, it's your responsibility to do this and this. So it's from the perspective,

> rather than thou shalt have a turn. But these kids are very...well justify you know, I haven't had to turn recently, it's my go. They are very assertive in the way, most of them.

Management of the learning context / planning units and activities

T identified a number of considerations when planning units and activities. A prime consideration is an awareness of planning to meet the needs of individual learners. T has a diverse mix of students in her class. While the class is ability streamed, there is still a spread of ability with some students who are ranked in the top 1% in the country in particular curriculum areas. In addition, the decile 10 school has attracted a large number of students for whom English is a second language.

Irrespective of ability or language barriers, T considers the provision of a variety of hands on activities to be essential for all students. "Trying to get as much hands on type activities as possible. Because I, you know, have that philosophy that kids learn through doing rather than me being up the front."

When planning both the Aztec and Kitchen Chemistry units, T drew on a range of resources and other educators. For each unit, T referred to the curriculum documents to ensure she complied with the prescribed National Curriculum objectives. When planning the Kitchen Chemistry unit T used one of the science curriculum support documents and also enlisted the support of a College of Education science adviser and one of her student's parents who is a secondary school chemistry teacher. T also drew on material she had used in previous years.

> I basically used one of the support documents that's come out for science national curriculum, and that's "Making Sense of the Material World". And I just thought, okay if the Ministry's very kindly written units for us, we'll see how good they are. So I used one of those as a basis. Then 'S' was doing some work in my room with students. She's a science adviser at the College. So I said, okay what can you offer me in return for having your students? She fed some information in. And then using previous units over the years looking particularly at powders, but then I had a look at other things like the hokey pokey and brought that in too. So once you had the basis of it, then looking at how you could feed those experiences in.

T was faced with more complex planning considerations for the Aztec unit.

> First of all, looking at the strands that I needed to cover from the curriculum statements. So it was really marketing some sort of...looking at the bartering system, I wanted to get that in. I wanted to try and get them to have a general overview and try to work out where to start first, so they'd got a bit of factual knowledge before we delved into other areas. So from the curriculum document it was the bartering or the trading as well as looking at the differences between New Zealand and getting some of the class system or gender base. It ended up with the class system because that was a little less fractious I think. The kids were a bit more on task with that. So, having a look at how the past was recorded by different people in different ways.

Modifying and adapting lessons and activities in response to student needs

T acknowledges the need to be responsive to students' needs and the issues that may arise for them which may not have been apparent or anticipated by her during the planning phase. T's comments on the need to adapt and modify her planning and teaching as the units progressed illustrate some of the reasons why teachers make spontaneous decisions that may result in significant changes to what they had originally planned to teach.

Several changes to the structure of lessons and activities resulted from assumptions T had made about students' existing levels of skill and knowledge. In the Aztec unit, the students' lack of prerequisite skills in mapping resulted in T spending three sessions instead of the single session she had planned. The debates around gender issues and class systems had to be modified due to the immaturity of the students and their lack of knowledge of debating protocols. T changed the composition of the two debating groups when it became obvious that individual students were too dominating or alternatively, when she noticed others who were excluded.

> The two groups had dominating characters. You notice I took Carly off and put her in the other group because they didn't have anyone to naturally dominate them. So I thought well quick, get her out of there and put her over to the other group. But there were some kids who weren't participating, that were on the fringe. I sort of stood back because I wanted to see what was going to happen more than anything. And then sort of change tack so the kids that were coming up and having their opinion. They actually quite liked that.

During the Kitchen Chemistry unit when the students were undertaking the popgun and boat activities, T noticed six girls wandering around outside, passively watching the groups carry out their experiments. T realised the girls had been excluded from their respective groups by the boys and encouraged them to reform into a group of their own to carry out the pop-gun experiment.

One of the most significant reasons for T making changes occurred as a result of students bringing up issues that she had not anticipated. T was conscious of the need to respond to the students' questions or issues, but on reflection expressed some anxiety about her own level of scientific understanding and whether she had given the correct response.

> The kids came out with different ideas from what I'd expected every now and again. So they threw something that was like a sideways issue for them, but I tried to incorporate it, so it was a lot of thinking on my feet all the time of what they were saying. And then the challenging of my scientific background and saying I don't actually know the answer to that, I'll have to go and find out. Or, is what I've said actually a fact or have I fed a whole lot of rubbish to the kids? You know, at the end of the day when you're thinking on your feet and you think oh, I think that's right but maybe on reflection it's not, and maybe I need to clarify that at the beginning of the next session. I didn't really think about it much until the end and then I thought, oh I hope I haven't misguided anybody hugely.

Individual and collaborative goal setting

T uses collaborative goal setting with individuals as an integral part of the evaluation process and for inclusion in the students' portfolios which are shared with parents at parent / teacher / student interviews. T has a strong belief in the need to inform students of specific learning objectives, required learning outcomes, and the expectations she has of their performance. T detailed a range of structures used to support student attainment of expected outcomes such as deadlines.

Expectations of student performance and the development of learner independence

Consistent with T's stated philosophy is her belief in the importance of increasing learners' independence and willingness to accept responsibility for their learning. T suggests that teachers should be transparent in the goals they set for their learners. Conscious of the time constraints and what has to be achieved within a specified period, T commented on the need to provide scaffolds in the form of foci displayed on the white board.

> I think it's the balance. It's the time management, it's the focus on what you're doing, what you're trying to achieve in the short period of time. I often put the focus up on the board. What is it you're trying to achieve? This is what I want you to have achieved or be working on. And now here's a list. Go through from the top. And it's creating that independence and those personal goals really, and the effectiveness of what you're doing. Now you might zip through the whole list but your thinking has only ever been on a surface level. And yes, you've gone through the whole process of a task but it could have been of a much higher standard if you'd put in a bit more effort. So there's the kids that'll whip through and finish quite happily and to an acceptable standard. But it could be better quality. Then you've got others that don't finish. And then you've got another group of very conscientious kids who are often girls, who finish everything to a high degree because they've got that self responsibility, self rules.

T considers that the expectations set for students is critical in terms of the quality of work that students produce.

> Teacher expectations are hugely important. Take the likes of Mel who I would consider to be at the lowest end of the class, yet he was still able in his own way to get up and present what he had done. So the expectation was not that he couldn't do it. So if you set that sort of...I'm only expecting this much, that's what you'll get. And if you look over the tapes you'll see that very early Mel says I've finished. And that was probably the second session. I've finished. OK, well how are you going to present it, what are you going to say? How are you going to organise your speech? And then he came back and said I haven't got enough information. Right, well go away and do that. I think the kids' expectations of themselves are fairly important. You get some kids who are quite critical of what they're doing.

T discussed a range of strategies she uses to encourage students to be self-managing and organised. These include the use of deadlines, whole class and group presentations, and the use of student reflections to evaluate their performance.

> I think one of the things that works really well is the use of deadlines and the way you're going to present what you've been doing. Now if that presentation's in front

> of an audience, whether it's their peers, whether it's their parents...we did something earlier this year and it was in front of a group of ICT teachers in the Convention Centre and so they knew they had to get everything sorted out. I've got the reflections on things with the kids during that time. And that was the overwhelming thing for them. They said yes, we did a good job but we didn't use our time well. What we achieved in the end, it took us three weeks of solid work but we could have used it a lot more effectively and had a better outcome.

Another strategy used by T is student peer evaluation using the PMI approach where students are asked to make comments on those aspects of a presentation they consider to be positive (P), a minus (M) or of particular interest (I). T was open about her use of the PMI system to make public examples of those students she considered to have been wasting their time. When asked about her impressions of the students' individual or group projects in the Aztec unit she stated:

> Well, the children that normally worked hard, worked hard. And the kids that just get up and skirt around the edges, skirted around the edges. I was particularly keen to make an example of Ned and Dexter in terms of the fact that they mucked around until the very last minute. And I wanted to point not only to them, but also to Randal, those kids that don't have a great work ethic. I wanted them to have the chance to have the presentation but then for the children to give them comments. And that was the idea of PMI, particularly the minus part. And Dexter got very sensitive which he does when he gets criticised. But you know, he's a very able kid but he will always have problems, he and Ned, because they'll always gravitate towards kids like them. And they've got to realise that you know they did muck around. They went from here to there to spend a lot of time wasting time, having a look around, and then suddenly the deadline was there, and oh well, I haven't finished. Well, get up and present what you've done.

T also considers it is important for teachers to be honest in their response to students who question why they have to learn certain things, using Premack's Rule where necessary to complete a least preferred activity.

> If they say oh why do we have to do this? Well, you know I'm required to teach this. It's in the National curriculum. I'm required to teach it, you're required to make sure you learn it. But if we get through this than the sooner we can get onto something else.

Evaluation of student progress throughout the units

T reported to be generally pleased with student outcomes from both units. In evaluating the units T considered students had developed in the following areas:

Development in oral skills and interactions between students

T made several references to the need to encourage students to express their opinions in the classroom context. In her experience of working with high ability students, T has noted that at times their thinking skills are in advance of their oral skills.

> I think the thing that came through is the children's oral skills. They're actually now able to explain, tell somebody else what they've done, comment on somebody

> else's. And it's taken a long time because fairly able kids are often not very good at orally explaining things. And in the end when we were doing PMI, I was just randomly choosing on purpose just to try and put the kid on the spot in a different oral situation and say, well, what do you think? And occasionally the child might say I don't know. I try and leave it for a period of time until it gets too awkward and then move on, but actually give them some thinking time.

At times, T's interactions with some students was quite sophisticated, including the use of humour. Students are encouraged to express their own opinions and the more confident students are prepared to do so, even if they are at variance with T's. While some interactions are considered to be immature, as evidenced in the debates during the Aztec unit, T is prepared to accept them as part of the students' development.

> Because of the way the classroom's run, there's a certain amount of interaction between the kids, and that's quite humorous and that sort of thing. I would have like the debate to have gone a little bit better than it did but I was quite happy with it as it stood.

T is intolerant of students who make inappropriate or disparaging comments.

> I think the only reservation I have about that are people like Callum and Ned and Dexter who do the slinging off or who interject or put someone down in what they're saying. And I really try and stamp on that every time they do it and say, that's not acceptable, don't say those sorts of things.

A further area of development noted by T during the year was in the reduction of verbal domination of classroom by the boys and the increased confidence of the girls to express their opinions and contribute to class discussions. In the interview conducted after the Kitchen Chemistry unit, T was very aware of the domination of the activities by the boys, stating;
"It's the girls often particularly in this class that will sit back."

Six months later (at the end of the Aztec study) T commented;

> If we'd done this in the first term you would have found very few interactions amongst the girls. The boys were very dominating in the class. And I think mainly because the girls saw them as having all the knowledge and the answers. And so they (the boys) were up on the next level, so the girls were very quiet and just sort of let them dominate the class. So it's actually become quite different.

T's awareness of the need to encourage individuals to contribute and to take advantage of asking the more reticent students to respond is evident in her discussion of Rewa, one of the Aztec study subjects.

> Rewa's very quiet anyway, but when she puts her hand up... she's one of the kids you think, oh she's got her hand up, ask. But those sorts of things. It's just being aware and tuning all kids in really.

Development in thinking skills

There was a marked focus, particularly in the Aztec unit, on thinking skills. T commented that she had noticed a development in the students' ability to engage in deeper level thinking, using as an example Jeff, a student she considers to be quiet in the classroom context.

> I've spoken to the kids quite a lot about the higher level of thinking, the deeper thinking, rather than just on the surface, what you think. And I think that's developed through the unit. And even the amount of knowledge...even like the class system where we had the kids with their own opinion, some of them were just intriguing I thought. Like Jeff, he's very quiet and doesn't offer that much. But when he does offer it's always really to the point, very succinct and very detailed. It just shows that level of depth in his thinking.

Development of research skills

T was pleased to observe the increase in students' research skills during the Aztec unit. T commented that about half of the students' reading ages were three to four years above their chronological ages. T uses an evaluation process for inclusion in the students' portfolios where students nominate individual skills they wish to develop. Several students had nominated speed-reading and how to skim and scan, as skills to develop that would help them when researching. T acknowledged the need for further development in students' ability to write research questions, particularly open questions, but was satisfied that the majority of students were now able to write research questions and summarise information rather than simply copying information from books.

> I think I've got most of them away from writing out of a book. To ask your own question and actually put it in your own words. Probably the only person that is inclined to do that still is Mira, because the parental expectations are so much different in terms of the culture than the other kids. But I think most of the other children have finally got you know; write in your own words. What does it mean for you? What's it going to mean to somebody else reading it?

T also noticed that students persisted longer than previously when looking for information. In response to my comments on my observation of students using a variety of sources when trying to find information for their research projects, T stated:

> The kids have to be trained to do that because a lot of the time earlier in the year they would have hit the wall and stopped. They would have just said the information's not there, there's nothing there, I can't do it. And we saw a couple of kids change topics because they couldn't find the information they wanted, but that says more about their work and study skills more than anything.

Development in presentation of research

T is encouraging of students to be creative in the way that they present their research, and was pleased to observe students using a wider variety of methods than previously.

> In terms of my expectations, what I've been pleased with is the kids chose different ways to present their information. At the beginning of the year if we'd done that, they would all have gone for the written presentation. But using the computer,

> using some drama or some plays or things like that, all lends itself open to different creative ways using most of their talents which makes a real difference.

Consistent with T's encouragement of students taking a deep approach to their thinking is her encouragement of students to focus on presenting interesting, factual information. "That's what we've been sort of hammering all year, is that get it based on the factual information, not just the pretty pictures."

Increased responsibility for learning

In the interview conducted at the end of the first unit, T commented that although the students were of high ability, their independent skills were not well developed. T attributed this to the students' previous classroom that had been very teacher-directed. T described how she used a structured approach to developing learner independence by gradually introducing elements of choice in subjects such as reading, writing specific achievement objectives on the whiteboard, and setting time limits for activities. T also commented on the importance of monitoring student's progress in achieving the selected objective, and in the development of their independent skills.

> I don't think their independent skills are very well developed at all. And I don't think a lot of them make choices very well about what they're doing. And I've done quite a lot of follow up to the reading, and in some cases there wasn't a lot done during the time. And I said, show me what you've been working on. And I'm always monitoring them. But there were maybe six kids who could not make a choice so every day they were going and doing something different and not really achieving anything, not completing anything. I think a lot of them had come from a class that was very controlled and you know, spoon-fed all the time. And I think that makes a huge difference. And I started giving them a bit more independence but saying right, here are the achievement objectives, here's what we have to achieve. What I want you to do is write how, what you're going to do, the time limit for finishing etc etc. Now some kids could do that really well and others just don't have those work habits to sustain that. So they do need structure.

In the interview conducted with T approximately six months later (at the conclusion of the second unit), T had noticed an increase in the level of students' independence and their willingness to accept more responsibility for their own learning.

> I think they've taken on a bit more responsibility. I mean there were sessions there that I didn't even need to be there. I felt totally useless really. Because I mean, I went around and interacted but I didn't actually need to be there, especially when they were just getting themselves organised and they were all focused and totally knew what they were doing. And I was amazed you know, I looked around the room at one point and I thought I don't even need to be in the room. I went for a wander outside and then sort of came back in and they were still focused on what they were doing.

T commented that it was still important to provide deadlines to provide motivation and to ensure the attainment of stated goals.

> I think that giving them a deadline, saying you will have three to five minutes on this day to present your work, suddenly gives them the drive to get things done. And that's hugely important, rather than saying oh well, we'll present this later. You know, you need to on this day to have this, this, and this. It's like the end goal. Even as adults we need the end goal. I think most of them managed their time pretty effectively in the end.

Constraints on practice

T identified five main constraints on her practice:

- the National Curriculum;
- the Education Review Office's (ERO) procedures for assessing learning outcomes;
- parental attitudes and expectations;
- opposing philosophical belief of colleagues;
- time constraints.

These constraints are discussed individually.

Constraints of the National Curriculum

T considers that the constraints of the National Curriculum on her practice are significant. T is particularly enthusiastic about using the research process as an effective tool to motivate her 'high ability' students to engage in the learning process. Her comments indicate the tension T feels between being able to use the research process in such a way that she can comply with the documentation required to demonstrate student attainment of the prescribed National Curriculum objects.

> The constraints of the curriculum – I think that's huge. And its things like where can you document all of this? One of the things I love is the research process and going through all that, but it doesn't fit nice and neatly so you can tick a box off the National Curriculum sheet.

Constraints of ERO's procedures for assessing learning outcomes

T acknowledges that while some of the National Curriculum objectives are quite broad and allow teachers some flexibility and choice in how they deliver the curriculum, T considers that the tick box method used by ERO to assess student learning is incompatible with her preferred approach to teaching. Following on from her comments about not being able to tick boxes off on the National Curriculum sheet, T stated:

> ERO's taken a few schools over the coals for that, because they haven't been able to tick the boxes. Now what they haven't looked at or talked about to the kids is actually what they learned during that time, which is a phenomenal amount of learning. So I think one of the constraints is obviously the National Curriculum. And even though in some cases it's quite broad, so that you can be quite specific you've still got to tick the box. But you don't only have to tick the box now, you also have to say how well the kids have met each of the objectives.

Constraints of parental attitudes and expectations

Parental attitudes and expectations of their children's education are an important consideration for T. In T's experience, teachers have less contact with parents as children advance to higher-class levels. T therefore regards the high level of interest and support from parents for what goes on in her classroom as positive. T considers a unit has been successful when parents comment on their child's continuing enthusiasm for school activities in the home context.

> The parents are very supportive of what goes on in this class. I think that the difficulty at this level is that you don't see the parents very often in Year 5 and 6...I mean you know it's been a good unit when you're having parents come and talk about the chemistry unit and what they've been teaching their younger brothers and sisters about it...So for the kids to have that sort of interaction with them at home and be actually talking about what they're doing was quite major for those households.

There is an obvious tension between parental interest and support and the attitudes and expectations that some parents have of their children's and teachers' performance in the decile 10 school.

> Some of the constraints are parents' attitudes. Having just been through the interview process, a lot of parents at our school want to know where the kids are, not only in National Curriculum but compared with peers their age. They want to see test results. They want to see pen and paper results. They want to see graphs. They want to see statistics...and they can't get over the kids can have responsibility for their own learning in many ways.

T considers it is advantageous to have the students attend mid-year interviews with their parents and is frustrated that some parents do not agree with her and refuse to allow their children to attend.

> You know, I had one parent who...I had the children in on the interviews, most of them, not all of them, and it came to the end of the interview and I said I realise so and so's not here. "I don't believe in my children coming to interviews. It's a parent teacher interview. It's got nothing to do with my child". And I said, well hang on; this portfolio's everything your child's worked on this year. Don't you think it's a good idea that your child also knows, so we can have a round table discussion? You know, he knows where his learning is, I know, you know. We're all getting the same message and we can set goals for him to. "No, no, it's a parent teacher discussion. If you've got a problem with my son then you say and you fix it up because you're the teacher". So in some instances still that's a very biased parental attitude too. That you're the teacher so you have to teach and we want our kids to be able to add things up. We want them to be able to read. And that's the main priority for us.

T's comments also show the tension she feels between her preferred practice, in particular the use of the research process, and the limited understanding some parents have of the teaching/learning process and their narrow perception of what constitutes appropriate or 'legitimate' learning experiences. T used the example of a whole school art unit conducted in the first three weeks of the school year.

> Our big drive at the beginning of the year was in art education. We were doing painting and using computers and doing a lot of research and that in painting cause we wanted to choose something that wasn't the norm. Well, we got a lot of discussion from parents about "the only thing the kids have done in the last three weeks is art. That's the only thing they've done. They haven't done anything else." But they can't see what we did. Because we knew that question would come up, we made a ten-minute video, putting all the stages together so the parents could see it. And yet we still had that opinion and people coming to Jean (the Principal) and saying "Oh well, they're only doing art.". But other parents were also saying "But look at what they've done. Look at what our kids have achieved."

Time constraints on practice

The constant pressure of time was considered to be a significant constraint on T's practice. During the Aztec study and in the post-unit interview, T made several references to the impact that time had on her ability to achieve the objectives she had planned to meet. T commented that as she had limited understanding of the topic herself, she needed to spend additional time in planning the unit.

> I probably spent more time planning this unit than I have others because I had to read first and find out everything first and then try to decide what areas I wanted them to concentrate on. And then what I did was have a look at some of the social studies approaches you can use...I used one of Kelvin Smythe's ideas originally like the mapping exercise right at the beginning. The words, the interpretation of what the words meant to the Aztec people and those sorts of things. So that was really setting the scene up.

In evaluating the activities planned for the Aztec unit, T commented on the extra time she had to spend providing a context for the unit about which the students had no prior knowledge, and the excessive amount of time required to teach the students basic mapping skills.

> Some of the kids I realised didn't know some of the very fundamental things of map reading...I probably presumed the kids would have a bit more knowledge than they did, and then was faced with rather than one session on mapping skills, it took three...For a start the research took a while to get off the ground. We sort of rushed through like the key questions, the closed and open questions and all of that, even though we'd done it before. And the closed and open questions, you will have noticed that some of them...they called them open questions but they were all closed. And we didn't really have the teaching time to go back and say hey, this really is a closed question, it's not your opinion, you're still getting the factual knowledge straight out of a book. That type of thing. And probably spend a bit more time getting information in their research books because for some of them their booklets just got cast aside. As the deadline came they thought gee, better get something done. I haven't got the time to write in there as well. We'll just do it straight away.

This is considered to be a significant comment as the success of the students' independent research projects was largely dependent on the quality of the questions they designed as the basis of their research. T knew that the students did not understand the difference between open and closed questions as she had collected their draft booklets in to check the appropriateness of their open and closed questions. Due to pressures felt by T, a conscious

decision was made not to spend additional time to address and correct student misunderstanding, at the risk of compromising the quality of the research that was to be undertaken over the following three weeks.

While T was unprepared to spend additional time on clarifying the question writing activity in the Aztec study, she was prepared to spend time persisting with an activity that she considered was not effective and that was beyond the maturity level of the class, in order to maintain control. T had prepared a debating activity about gender roles in Aztec society. The students were too young to debate the issues objectively, with many making inappropriate comments causing several students to become excited, excessively noisy and consequently difficult to manage.

> T he gender activity was obviously unsuccessful because I think some of the kids were just to immature to handle it which was a shame really because I think there were some kids there who could have handled it quite well. And I battled through it. I'd thought about cutting it but I thought I didn't want them to you know, get the better of the lesson and what we were going to do anyway.

T had identified activities that she would like to have extended but was unable to due to the amount of time that had already been spent on the unit. Commenting on those activities which she had been particularly effective in achieving the outcomes set for the unit T stated;

> I think particularly looking at the class system at the end. That was something, I probably could have carried on further but you know the time, the time was...we'd used up so much time over the five weeks really...Probably would have spent more time...looking back I probably would have kept the unit going for a whole term in a bit more detail so that the research process could be extended.

There was a clear tension between T's encouragement of her students to take a deep approach to their work, and the constraints of time which limit her ability to take the same deep approach to her own teaching. T's comments are consistent with the other three teachers in the studies, who all commented on their frustration at not being able to undertake topics in sufficient depth.

Constraints on teaching in a context where staff do not share common philosophies

T was pleased to be teaching in a school with a Principal who shares her philosophy and who she regards as progressive and genuinely concerned about children's learning. T commented that the 'freedom' she enjoys to implement her philosophy in the classroom is due to the fact that she had been specifically employed to motivate and teach a high ability streamed year 5 and 6 class. T specified it was not the result of her position as Deputy Principal.

> I would see less constraints at this school than I had at my last school. I don't think that particularly comes with being the DP. And less so from Jean being the Principal. She's very open, wanting the kids to learn. I was employed to motivate these high ability kids in a different style programme. So I've been given...you know, I still have to fit into the maths interchange and that sort of thing. But within

> those constraints I don't need to teach formal group reading so that gives me leeway to do other things.

While T feels supported by the Principal, she considers that some staff members who do not share her teaching philosophy can be obstructive. When it was suggested that her philosophy may be considered to be quite advanced, T commented:

> I think you get knocked back quite a lot with people's opinions. And people who are stuck at the ground level and can't see beyond that sort of ground level. And they don't have the perception of what else kids can do and how they can do it.

T discussed the impact on her own practice of the very formal classroom that most of her students had experienced the previous year, with a teacher who did not share her philosophy.

> I think a lot of them came from last year. Came from an experience that wasn't hands on. It was very much formal. Sit at your desk. Don't speak out of turn. Don't move around the classroom. Watch what I am doing. So that very formal style of teaching. And so it has taken a while to get them into the...you know, yes I can say what I think.

Discussion

New Zealand teachers are required to implement the New Zealand Curriculum (1993) in their classrooms. The New Zealand Curriculum is the official policy for teaching, learning, and assessment in New Zealand schools. The New Zealand Curriculum specifies eight groupings of essential skills that need to be developed by students across the whole curriculum throughout the years of schooling (p.17).

The eight groupings of essential skills are:

- Communication Skills;
- Numeracy Skills;
- Information Skills;
- Problem-solving Skills;
- Self-management and Competitive Skills;
- Social and Co-operative Skills;
- Physical Skills;
- Work and Study Skills.

Listed under each of the categories are a number of specific skills and attributes that are considered to be essential for all students to develop.

T's stated philosophy of teaching and learning and the development of skills that she considers to be of primary importance comply with the requirements of the national

curriculum. To illustrate the high degree of congruence between those skills that T considers to be important to develop, and the essential skills as specified in the New Zealand Curriculum Framework for all students to develop, the relevant skills from each category have been selected and listed below.

Communication skills

Students will:

- communicate competently and confidently by listening, speaking, reading, and writing, and by suing other forms of communication where appropriate;
- convey and receive information, instruction, ideas, and feelings appropriately and effectively in a range of different cultural, language, and social contexts.

Information skills

Students will:

- identify, locate, gather, store, retrieve, and process information from a range of sources;
- organise, analyse, synthesise, evaluate, and use information;
- present information clearly, logically, concisely, and accurately;
- identify, describe, and interpret different points of view, and distinguish fact from opinion.

Problem-solving skills

Students will:

- think critically, creatively, reflectively, and logically;
- exercise imagination, initiative, and flexibility;
- inquire and research, and explore, generate, and develop ideas;
- design and make;
- evaluate processes and solutions.

Self-management and competitive skills

Students will:

- set, evaluate and achieve realistic personal goals;
- manage time effectively;
- show initiative, commitment, perseverance, courage, and enterprise;
- develop the skills of self-appraisal and self-advocacy;
- achieve self-discipline and take responsibility for their own actions and decisions;
- develop self-esteem and personal integrity.

Social and co-operative skills

Students will:

- develop good relationships with others, and work in co-operative ways to achieve common goals;
- take responsibility as a member of a group for jointly decided actions and decisions;
- participate appropriately in a range of social and cultural settings;
- develop the ability to negotiate and reach consensus.

Work and study skills

Students will:

- work effectively, both independently and in groups;
- build on their own learning experiences, cultural backgrounds, and preferred learning styles;
- develop sound work habits
- take increasing responsibility for their own learning and work.

In summary, it is evident that T's stated philosophy of teaching and learning, and her articulation of best practice is consistent with the requirements of the New Zealand National Curriculum (1993). The extent to which T's stated philosophy was implemented in classroom practice has been demonstrated in Chapters 5 and 6, and is discussed further in the next chapter.

CHAPTER 8

Discussion

The following discussion is based on the findings presented in Chapters 5, 6, and 7 and is presented in four sections. In section one I discuss selected key findings in relation to the teacher's planning of the Aztec question writing lesson and the chemical pop-gun and boat lesson. In section two I discuss key findings in relation to the instructional, activity, and report writing / whole class discussion phases of the two lessons. Section three contains a discussion of the significance of the classroom discourse within the two lessons. This is followed by discussion of the significance of classroom culture and the unique ways that individual subjects experienced the classroom. Section three concludes with a discussion of the challenges faced by the teacher in her implementation of constructivist practice. In section four I discuss the way that the findings have challenged my previous conceptions and misconceptions of schooling. Using the metaphor of 'the game of schooling', I describe how my findings contest the perceptions of contemporary schooling held by the wider educational community.

Section One

In this section I discuss selected findings in relation to the teacher's planning of the Aztec and Kitchen Chemistry units with a focus on the following aspects: the way the teacher planned to meet the needs of individual students; opportunities for student choice; the significance of student interest on task engagement, and issues related to the teacher's planning of group tasks and the contrasts between the teacher's and students' perceptions of how effectively the groups functioned.

The quality of teachers' planning is considered to be fundamental in determining the extent to which an individual student can access the curriculum, and the opportunities they have for cognitive engagement. Classroom tasks are particularly significant as they are the vehicle through which the curriculum is transmitted to students (Doyle, 1983; Fisher & Heibert, 1990; Turner, 1995; Alton-Lee, 2003).

In initial meetings held prior to the commencement of each unit, the teacher discussed details of her planning and the concepts she had selected to teach. The teacher articulated a number of constructivist principles in relation to her planning, emphasising the need for students to be active in the learning process and to have opportunities to contribute to classroom decision-making processes. The teacher discussed the importance of prior learning as a basis for her

planning and the benefits of incorporating some student choice in her planning. She considered collaborative group tasks and the provision of opportunities for students to learn from each other to be beneficial. The teacher felt it was important to create opportunities for students to monitor themselves during task performance while holding them accountable for task completion. Consistent with the literature, the teacher agreed that effective tasks incorporate challenge, student autonomy, student interests, and social collaboration (Turner, 1995; Nuthall, 1999).

Planning to meet the needs of all students

The teacher was aware of planning programmes of work that would meet the needs of all of her students. Although the class had been established to accommodate high achieving students, the teacher was still concerned that the tasks she assigned would not be sufficiently challenging or motivating for particularly able students like Rod. The teacher commented:

> "I'm very aware of trying to cater for everybody's needs. It's difficult trying to motivate Rod as well at the top end. And that's one of the reasons I brought Ann in as the chemistry specialist. Because Rod is, because he's in that top like 1% of kids in New Zealand of his age, it's really hard to motivate him and hard to know whether or not he's actually interested in what he's doing."

The teacher had invited a high school science teacher to conduct two chemistry lessons within the unit. In evaluating the two lessons the teacher considered that the content of the sessions was helpful in extending students like Rod but were "a bit high powered" for most of the students. Rather than fitting into the "flow" of the unit as she had originally planned, the teacher considered that the two lessons became isolated components.

Consistent with the teacher's concerns about meeting the needs of all students, the subjects also discussed the need for tasks to be challenging yet achievable.

Interviewer:	What sort of work should teachers give children to do?
Rewa:	Don't give children work that is too hard for them. Have different levels and let the children try out which ones suit them best.
Ned:	Make the work like to their level... not too hard, not too easy.
I:	As a teacher, how could I do that?
Ned:	Sort of just monitor them.
Jack:	When teachers just put stuff on the board to copy, you don't really think about it, you just write it down.

As a way of dealing with some of the less desirable tasks, the teacher emphasised the need to share with the students the reasons why they were required to do them, commenting:

> "If they [the students] say oh why do we have to do this? I say, well, you know I'm required to teach this. It's in the National Curriculum. I'm required to teach it and you're required to learn it. But if we get through this then the sooner we can get onto something else."

My findings demonstrate the need for teachers to match tasks to students' achievement levels. If tasks are perceived to be too challenging or time consuming, students will negotiate down the task requirements (Doyle, 1983). In response, teachers reduce the cognitive level and challenge of tasks by placing a premium on effort or presentation or by giving credit for less difficult aspects. The emphasis then goes on the superficial aspects, dominated by students' concerns about completing and handing in work, and teacher talk that is not about content, but about finishing, underlining headings, and generally maintaining order (Nuthall, 2001). The need for teachers to plan curriculum appropriate activities that allow students to practise and apply their new learning in authentic, relevant contexts is indicated (Edelsky, 1991; Greeno, 1997; Alton-Lee, 2003).

Resource planning and use

As an integral part of her planning, the teacher had selected a range of resources on which to base her teaching of the two units. The teacher's primary planning of the Aztec unit was based on commercially produced resources. The teacher had also sourced a wide range of books for students to use. The books proved to be a valuable resource and were used extensively during the unit. In addition, the students had access to classroom computers and the internet.

As reported in Chapter 5, the teacher based the instructional phase of the Aztec question writing lesson on a commercially produced sheet called "Skills Hand: Designing Questions". The teacher had selected the sheet to help clarify the differences between open and closed questions during the instructional phase, and for the students to use as a resource when writing their independent research questions. An analysis of the sheet showed that much of the content was irrelevant to the specific question writing activity and was therefore not well matched to the teacher's goals for the lesson. The teacher was then faced with having to spend additional time adapting much of the ambiguous and confusing information as she went through the sheet. The students lost focus and exhibited signs of boredom and off-task behaviour, increasing the teacher's management problems throughout the instructional phase. As the subjects could see little relevance of the information on the sheet to the actual task they were required to undertake, they did not refer to it while writing their questions. As such, the resource was considered to be an example of the kind of commercial text regarded by Blumenfeld (1992) as being a poorly conceived attempt to include variety or interest.

A major resource issue for the teacher was the lack of a specialised classroom facility or laboratory in which to teach science. In the post-unit interview the teacher expressed her frustration at having to teach science with inadequate resources in the confines of a crowded classroom. The teacher's concerns were most evident during the pop-gun and boat experiments. Students were observed to haphazardly use improvised equipment while engaged in the two experiments. In the boat experiment blunt scissors were used to pierce and cut holes in heavy plastic bottles. One of the water troughs intended for students to trial their boats in had a hole in it. The leaking water made the classroom floor slippery and unsafe and was a further distraction for the teacher who had to find another trough and organise students to mop the water up.

The groups carrying out the pop-gun experiment had to work outside. As there were insufficient tablespoons and measuring cups, several excited students mixed the baking soda and vinegar indiscriminately. Contravening the teacher's instructions some students shook the bottles in an attempt to speed up the chemical reaction. Other students held the fizzing bottles close to their faces or ran up to stand over the bottles and waited for the corks to eject. It is acknowledged that some of the problems related to the use of resources were management issues due to the students being engaged in two different activities, both of which had elements of risk attached. In addition, the teacher's management problems were compounded by the fact that the students were spread over a wide area with some working inside the classroom while those conducting the pop-gun experiment outside had moved well beyond the area designated by the teacher.

An additional issue related to resource use was that of equity of access and active participation of all students. Examples have been provided of how low status or less assertive students like Beth were excluded from accessing resources due to the domineering behaviour of the boys in her group. When asked to write two new things she had learned at the end of the science lesson Beth wrote "I learned you have to be patient". While Beth may have been alluding to the fact that she had to wait for the experiment to work, Beth had also learned that she had to be patient when waiting for a turn to access the resources.

Irrespective of how aware teachers might be, their ability to see what is occurring for 30 plus students simultaneously is extremely limited (Nuthall, 2001). As reported in Chapter 6, the novelty and excitement generated by the pop-gun activity resulted in significantly high levels of off task behaviour and talk. As a result, the teacher was mostly concerned with the management of resources and compliance with instructions for carrying out the tasks safely and sensibly rather than discussing the concepts involved in the task and monitoring student

understanding. My findings highlight the need for the adequate provision of suitable resources with close teacher monitoring of their appropriate and equitable use by all students.

Opportunities for students to be agentive in classroom decision-making processes

Opportunities for students to be agentive in the decision-making processes of the classroom is a fundamental principle of constructivist practice (Turner, 1995; McMaster & Bonallack, 1997) and is largely determined by the extent to which teachers are prepared to seek students' ideas and then act on them. The advantages of student choice, contextualisation, and the personalisation of tasks include deeper engagement with the content, increased motivation, increases in the amount learned, and heightened student perceptions of their own confidence (Cordova & Leper, 1996).

The teacher in my study advocated the need to provide students with opportunities to contribute to decisions about what they learn. In the Kitchen Chemistry lesson the teacher had selected two experiments to be undertaken. The students were assigned to an experiment rather than given a choice of which one they wanted to do. In the Aztec unit, the students were offered a choice of six aspects of Aztec life to research, based on what the teacher considered would be compatible with their interests and with the resources that were available. The teacher also provided the students with a range of options for how they presented their research including posters, role plays, booklets, or the use of a computer programme called "Hyperstack". The teacher gave the following rationale for limiting the students' choice to one of six aspects of Aztec life she had nominated.

> "You still have the same kids who are disorganised. If I'd said to them OK, choose any aspect of Aztec life you like, then it would have been even more difficult for those children that can't make decisions. But by giving them the six key words that we used, you have to choose one of the six, then it's not quite so difficult. And I also had a look beforehand and made sure that the books related to the topics. So you're setting them up to succeed anyway, rather than setting them up and saying, I know that you're going to fail by not having the necessary parts there."

The teacher advocated the gradual introduction of increased opportunities for students to work independently while clearly stating her expectations of what they had to achieve within a specified time. The teacher also explained that the children's lack of independence and inability to make choices was the result of the classroom they had been in the previous year. "A lot of them had come from a class that was very controlled and, you know, spoon fed the whole time. And I think that makes a huge difference."

In common with the teacher, the students emphasised the importance of being given opportunities to choose what they learned as demonstrated in the following post-unit interview excerpts.

Interviewer:	How important is it for you to have some choice about what you learn?
Ned:	It's quite a bit important.
Rod:	Well, it would probably be better if the teacher gave us more than one option, like a few different options.
I:	What difference does it make if you like what you're studying or what you do your research on?
Rod:	Well, it's like you get more work done and find information quicker and that.
Libby:	Let children maybe choose their own thing to do because some people enjoy different things.
I:	Do you think they'd learn more?
Libby:	Probably.
Rewa:	I think I'd learn more cause you'd be able to choose what you wanted to do and you can choose if it's an interesting topic.

There are tensions for teachers in relation to giving students choice about what they learn. My findings show that while students like to have choice about what they learn and how they present their information, they do not want to have to spend more than a minimal amount of time or effort finding and presenting their new information. Irrespective of their achievement levels, students shared a common preference for tasks that were perceived to be able to be undertaken immediately or with minimal requirements to access additional information on how to carry out the task. Despite the teacher's best efforts, the students still selected tasks that were perceived to be 'quick', 'easy', and 'fun'.

Interviewer:	Why did you choose to present your research the way you did?
Rewa:	We chose a poster because posters don't take a long time to do. Posters were easy to do.
Libby:	We decided on a booklet or a poster and we chose poster cause poster was easiest. The others seemed to hard and I didn't think anyone would be doing that.
Ned:	A poster was one of the quickest things.

The subjects' responses were consistent with the literature and show that when tasks fail to match students' interests or goals, the students just want to get the tasks out of the way. They don't care how they dispose of it and will turn to illegitimate means that wholly defeat

whatever purpose the task giver had in mind (Holt, 1982). The subjects' responses, their superficial approach to research, and their choice of activities that are "quick and easy" raise two questions for consideration. Does their behaviour reflect the fact that they may have become used to having a limited choice of what they do and a limited time within which to complete their own research? If so, is their behaviour a way to avoid the frustration of having to move on to a new unit before they have satisfied their curiosity?

The teacher considered the research process was a useful method of providing students with opportunities to construct their own knowledge and try to make sense of their understandings as they occur. In her evaluation of the Aztec unit, the teacher stated that she would have liked to keep the unit going for longer but lack of time and other curriculum demands precluded her from doing so. "Probably would have spent more time...looking back I probably would have kept the unit going for the whole term in a bit more detail so the research process could be extended...I could have kept it going a bit longer and maintained their interest."

The role of interest in task engagement

The role of interest in student task engagement has been selected for discussion because of the premium that the subjects placed on the relationship between their perceptions of task interest on their subsequent task engagement. Put simply, if a task was not perceived to be interesting, the subjects were resistant to engage with it other than superficially. Regardless of achievement levels, the subjects consistently mentioned the relationship between tasks that they perceived to be interesting and fun with the speed and ease with which they could complete the task. Tasks that were considered to be interesting were strongly linked to the subjects' perceptions of the value of the tasks in relation to their ability to learn and retain information. Even when a task was considered to be challenging in terms of the level of difficulty, the subjects were willing to attempt it if they perceived it to be interesting. The following interview excerpts demonstrate the importance that selected subjects placed on interest in relation to their task engagement and learning.

Interviewer:	Do you think it's easy for you to remember things that you hear or read, or is it hard?
Rewa:	Some things are easy. Some things are hard.
I:	What sort of things are easy?
R:	Things that are interesting.
I:	Do you have to do a lot of practising to remember or learn things?
R:	Not really, cause once it's in my head it's hard for it to die.
I:	What sort of things are easy for you to learn Rod?

Rod: Things that are easy...You should have fun cause otherwise, if it's all boring, you don't get much work done. Like, you go slower and fall asleep in the middle of it.

I: How did you choose which questions you wrote for your Aztec study?

R: I just thought about what things I wanted to learn...what things are interesting that I don't know.

Ned: I find it easy to remember things that I find interesting. Things that I find boring I don't really remember.

Conversely, the subjects were resistant to tasks they considered to lack interest or that had little personal relevance. They were most disparaging about having to do tasks that they considered were of no value, particularly tasks such as handwriting or those involving simple copying. Rod reported feeling happy when doing maths and most unhappy about having to do handwriting. "I feel just over normal happy when I'm doing maths...the opposite would be handwriting. I feel bored and annoyed cause I have to do it and I don't like it. Have to do it every day." Rewa commented: "School gets a bit boring sometimes...usually we're just writing things down and it gets a bit boring when we do that." Libby stated her opinions strongly. "The Aztec topic was mostly boring...especially when you had to do the social classes and stuff...that was so boring...I just like presenting things. I hate being up by myself, but if I'm up with other people it's not so bad."

With the exception of Ned who told the teacher that he "might be bored" when writing his Aztec questions, the subjects did not complain openly to the teacher about boring tasks. My findings raise the following questions. Do students accept that tasks like handwriting are an essential part of schooling? Alternatively, are they satisfied that although the task might be boring or lacking in challenge, it can be accomplished with little pressure and few cognitive demands on them?

The subjects had developed strategies for dealing with boring tasks, reporting they were able to "switch off" when the teacher said boring things. As stated by one subject: "I can switch off, but I can still hear if she changed the subject to interesting things...I'm sort of like, half of me is still there and half of me is gone." Her friend had another strategy: "I look at the clock, look out of the window, and think of other things." Rewa reported to "read things on the walls, sometimes fiddle, and talk to other people, although we're not really supposed to." These responses are consistent with how Holt (1965) described bored students 40 years previously: "Sitting still with hands folded and eyes glued on us or somebody, but their minds will be far away" (p. 157).

Interestingly, many of the students' interview responses indicated a pragmatism about the need for teachers to provide a mix of tasks they perceived to be "fun, interesting and easy" with those that were perceived to be "hard" or "boring". They considered that curriculum areas like spelling and maths simply had to be "learned" and there was a high degree of consensus that it was less fun learning spelling and maths than science or social studies. The subjects' comments appear to reflect the teacher's attitude to sharing the reasons why she was required to teach certain things and they were required to learn them.

An anomaly exists between the subjects' reports of feeling energetic and to working faster and harder when they are interested, and suggestions that teachers should provide a mix of interesting and boring tasks. Ned made some contradictory statements in relation to fun. Ned stated that he felt bored at school "Just because I don't really find it fun". He then said: "You can't make school like 100% fun because you wouldn't learn as much because you'd basically just be playing a game and you wouldn't learn as much. Twenty five percent should be fun. The other 75% just make it interesting and learn".

As demonstrated in the following excerpt, there were some inconsistencies in Rod's thinking about the role of interest in his learning. Rod had previously stated that he learned more easily when the task was interesting. In the following response Rod considered he learned more from boring things because they have got more facts and take longer to do than interesting things.

Rod: It [school work] should be interesting most of the time but you need a little bit of boring stuff...cause like it's got more facts and that. And like, interesting things I don't usually learn cause like they don't usually make you learn as much...it's more fun so you learn to do the things to do to make you learn quicker, much quicker, just do them quicker.

Rod qualified his statement by suggesting that boring things should be made a bit more interesting "but not too interesting...cause if it's interesting stuff you don't need as much of it cause it's just like playing around and that." Rod's comments are consistent with those made by the teacher in relation to the pop-gun experiment where she stated: "The chemical pop-guns, I mean, that was great but they insisted on doing it time and time again, which is fine. But in terms of their learning, well, they learned right at the beginning of the first one and that was the impact of their learning. Now they won't forget that but the fifth and sixth time they didn't learn anything different from what they did the first time."

The extent to which students perceive tasks to be interesting affects how they approach them. The subjects' comments are consistent with the literature where the significance of the relationship between students' perceptions of how interesting a task is and the extent of their subsequent engagement with the task is well documented (Christensen, 1994; Turner, 1995; McMaster & Bonallack, 1997). Their perceptions also affect their cognitions and behaviour while working (Ames & Ames, 1984). Of particular relevance here is expectancy value theory (Green, 2001) where the amount of effort students are willing to expend on a task depends on the extent to which they think they will succeed in it, and the degree to which they value the task and value their success on it. McPhail, Pierson, Freeman, Goodman and Ayappa (2000) found that students reported being happy and motivated when working on high interest tasks. The students were found to be reliable informants of their interests, and were more committed to tasks when working in their preferred learning contexts.

Consistent with the subjects' responses, the teacher of the Aztec and Kitchen Chemistry units acknowledged the importance of student interest in teaching and learning. When asked how the level of student interest affects the learning process, the teacher replied:

> "Hugely. If the kids are interested, then they do remember more, and they certainly show a greater knowledge. If there's low interest, then why? And if the kids aren't interested at all, I'd more likely say well what's the problem? Is it the topic, is it the curriculum area? You know, try and get some sort of a grip as to why. More often than not it's because of some experience in the past. It might have been taught to them in the past. They might have already covered it. They see it as going over the same old ground. It was a bit boring last time...Mum or dad said that's boring, so the influence of other adults. Sometimes it could be a skill they're not good at compared with the other kids, so it's a competitive thing...The kids that are really highly interested I've found have parents and resources at home that they can go home and say, hey, I'm doing this or that and the next day they'll come with some new found knowledge. For example, Elle, she continually does this. Now, I think this is just her level of motivation, you know, that is, her self-motivation of learning and generating knowledge."

In addition to the need for tasks to be interesting, there was consensus amongst the subjects in relation to their preference for tasks that were "hands-on." Rewa reported being happy when she was "making things" as opposed to doing worksheets. Libby was happy when she was active and "up the front presenting things with others." Jack didn't like just hearing about chemicals or watching teacher demonstrations, he wanted to "do them." When asked why it was important for children to do things Jack responded: "It makes it really fun having a go at it. Not like all the experts doing it all the time...They always do all the good stuff. Like they get heaps of goes and all that."

There are strong parallels also between my own findings and those of Freeman, McPhail, and Brandt (2002) where students reported they prefered activities that provided opportunities for "hands-on" experience, those that involved experimentation for example science activities,

and activities that allowed them to work collaboratively with their friends. Although McPhail, Pierson, Goodman and Noffke's (2004) study focused on students with learning disabilities, their findings in relation to student interest are relevant to all teachers. The authors advocated shared partnerships based on common interests, and the use of mentors to help foster communities of learners who share the responsibility for their learning.

During the post-unit interview at the conclusion of the Aztec study, the teacher acknowledged the importance of increasing her learners' independence and their willingness to accept greater responsibility for their learning. The teacher commented on the need to be transparent in the goals she set for her learners. Conscious of the time constraints and what has to be achieved within a specified period, the teacher emphasised the need to provide scaffolds in the form of foci displayed on the white board.

> "I think it's the balance. It's the time management, it's the focus on what you're doing, what you're trying to achieve in this short period of time. I often put the focus up on the board. What is it you're trying to achieve? This is what I want you to have achieved or be working on. And now here's a list. Go through from the top. And it's creating that independence and those personal goals really, and the effectiveness of what you're doing. Now you might zip through the whole list but your thinking has only ever been on a surface level. And yes, you've gone through the whole process of a task but it could have been of a much higher standard if you'd put in a bit more effort. So there's the kids that'll whip through and finish quite happily and to an acceptable standard. But it could be better quality. Then you've got others that don't finish. And then you've got another group of very conscientious kids who are often girls, who finish everything to a high degree because they've got that self responsibility, self rules."

The need for teachers to be facilitative rather than directive, and guiding as opposed to transmitting, is acknowledged, but there is a tension for teachers in providing authentic, problem-solving opportunities and offering students explicit guidance (Stein, McRobbie & Gibbs, 2000). Despite the substantial evidence of the benefits to students when teachers base their planning of classroom tasks on constructivist principles, there is a continuing disparity between tasks that are compatible with constructivist principles, and those most commonly assigned (Moroz, 1998; Barr, 1998). My findings highlight the need for teachers to consult with their students and to incorporate real opportunities for them to pursue their own interests.

Group tasks

The need for teachers to plan opportunities for children to learn through joint activity or the co-construction of meaning through classroom tasks is well established in the literature (Philips, McNaughton & McDonald, 2001; Palincsar & Herrenkohl, 2002). Proponents of cooperative learning and social constructivist learning theories advocate the use of collaborative learning contexts (Vygotsky, 1978; Johnson & Johnson, 1998; Palincsar, 1998)

and the benefits of tasks that allow for peer collaboration are confirmed (Wilkinson, Hattie, Parr, Townsend, Thrupp, Lauder & Robinson, 2000; Brown, Palincsar, & Campione, 1993).

Consistent with constructivist principles, the teacher in my study articulated the benefits of collaborative group tasks and used them extensively in her teaching. Typically there would be between four and six students per group for science tasks. Group numbers for social studies tasks depended on the type of task. There were generally four or five students assigned to group discussion tasks. There was also evidence of a number of smaller group tasks in social studies, with students given opportunities to work on projects with one or two peers. While the teacher most often assigned students to groups randomly by going through the class roll, she deliberately separated those students who she felt would not work well together.

In common with the teacher, the subjects consistently reported the benefits of being able to work together and to share their ideas and learn from each other. As demonstrated in the following excerpt, working with Elle boosted Rewa's confidence in her own ability to conduct her Aztec research on time.

Interviewer:	Had you ever thought about doing time before Elle mentioned it?
Rewa:	I thought about it but I didn't think I could do it.
I:	How important was it for you to work together?
Libby:	Quite important, I wouldn't have got as much information...We came up with the questions by ourself and then we joined together in the group and we chose the best questions and the best answers that we got.

The subjects also reported that it was important for them to be able to choose who they worked with. When asked how they felt when allowed to work with their favourite person, the subjects responded as follows:

Beth:	Happy and glad.
Jeff:	Happy.
Jack:	Kind of happy because we share ideas and they are not all his ideas.

When asked how they felt having to work with people they don't like, the subjects responded:

Beth:	I feel quite annoyed but still quite happy. I could still get the work done.
Jeff:	Makes me feel bored.
Elle:	Unhappy.
Jack:	Annoying, it just gets on my nerves. Makes me feel frustrated. I don't want to work with them. I could only just get things done.

From the above responses it is suggested that where possible, students should be given some choice about who they work with. As demonstrated in Chapters 5 and 6, there were a number of students like Rewa and Beth who were excluded from their groups. To minimise such exclusion there are a number of ways teachers might consider the composition of groups. Suggestions include the use of interest groups where students nominate an area of interest and work with peers with similar interests. Alternatively, teachers could consider a mix of teacher and student choice.

Teacher and subjects' perceptions of how groups function

My findings demonstrate a disparity between the teacher's perceptions and those of the subjects' in relation to how effectively the groups functioned. The teacher of the Aztec and Kitchen Chemistry units did not consider the need to assign specific responsibilities to group members or to work specifically on group roles, stating:

> " Because they're able kids you don't really need to...they have fairly well established cooperative skills.... So I haven't done a lot about group roles this year. It's more, you're part of a group, it's your responsibility to do this and this. So it's from that perspective, rather than thou shalt have a turn. But these kids are very...will justify, you know, I haven't had a turn recently, it's my go. They are very assertive in that way, most of them."

Interview data shows that while the teacher's comments were true of some of the more confident, assertive students, particularly boys, it was not true of some of the less assertive students, in particular several of the girls. While the subjects were able to articulate the rules for working well in groups, they often expressed their frustration about the dynamics of the group, particularly when they had no choice with whom they worked, and of the negative effects of domineering students.

The following excerpts are from interviews conducted with Elle and Beth at the conclusion of the Kitchen Chemistry unit. Elle was a confident student who enjoyed a high level of participation in a whole class context and in groups. When working with particularly domineering boys, however, she was resigned to having limited opportunities for participation.

I:	Did you find your group worked well?
Elle:	Not really.
I:	Why was that do you think?
Elle:	I think that didn't work well because they were mostly boys. I was the only girl in the group and Ned he's quite bossy. Thinks he's pretty cool, so he doesn't really let other people have a turn at things.

I:	What happens if you're not allowed to have a turn in a group?
Elle:	I basically just watch.
I:	What sort of things do you think children need to be aware of before you start putting them in groups or expecting them to work in groups?
Elle:	I'd expect them to know the rules about working together.

Beth was a much quieter, less assertive student than Elle. Beth appeared to accept that she was unlikely to be afforded opportunities to have a turn in a group situation. During the Kitchen Chemistry unit when the students were making chemical pop-guns, Beth left her group within the first minute due to the fact that the boys had immediately dominated the resources and it was obvious that she would be excluded from having any involvement in the activity.

I:	So how come the boys took over and didn't let you do it?
Beth:	I don't know, they're just boys I suppose.
I:	So do you think that's something boys do?
Beth:	Yeah.
I:	Could you have said, no we're doing it. Could you have done that?
Beth:	Well, not really, no. I just know really they wouldn't let us join in.

Domination of groups by one or two students was particularly evident in tasks involving computers, and in science activities where the boys would dominate, unless there was a particularly assertive girl in the group. Students most likely to be marginalized were those at the lower end of the classroom social hierarchy. They appeared to have learned to 'play the game' by accepting their position to avoid attracting the attention of the teacher or further social repercussions from their peers. Students who were marginalized tended to be able to sustain their interest for a short time before engaging in non-content related talk or returning to their desks and doing something unrelated to the set task.

Rod was an example of a student who was dominant in his group. His attitude towards other group members was demonstrated in the following excerpt.

> "I did most of the work cause the others were just being silly. Sometimes I don't like what other people do. They don't listen to me so I just do the work for myself and then they complain that I'm not letting them do any of the work. And I go, well, you're just being silly. If you don't stop being stupid, I'll kick you out of the group."

The following excerpt from the post-unit interview with the teacher demonstrated her awareness of the way the boys had dominated the chemical pop-gun experiment.

Teacher: We all went outside and it was the boys who had hold of all the containers, all of the vinegar, all of the baking soda. Now what were the girls doing? They were at the back having a chat. You know, there was a group of about six or seven of them.

What the teacher was unaware of initially was that the reason why the girls had formed a group of their own was because of the boys' domination. When she realised why the girls were standing back, she suggested they form their own group and provided them with the resources to make their own pop-gun. In the post-unit interview conducted after the second study, the teacher commented that she had noticed a decrease in the boys' domination within the class.

> If we'd done this in the first term, you would have found very few interactions amongst the girls. The boys were very dominating in the class...I think mainly because the girls saw them as having all the knowledge and the answers. And so they (the boys) were up on the next level, so the girls were very quiet and just let them sort of dominate the class. So it's actually become quite different."

My findings suggest that the teacher's expectation of the ability of Year 5 and 6 students to work effectively in groups without assigning group roles or monitoring them was based on her belief that her high ability students also had advanced social skills. Although the subjects could articulate the rules for behaviour when working in groups, they often did not apply them, resulting in the marginalisation and exclusion of some students. While it is acknowledged that group tasks can provide social and academic benefits for students, my findings suggest the need for group tasks to be carefully structured to ensure equal opportunities for all members to participate. Students need the prerequisite skills to ensure groups function effectively. Even when teachers are confident that their students understand the rules for effective group work, there is a need for close and on-going teacher monitoring of a group's understanding of the content of the task, their adherence to the rules for working in groups, and of their progress towards attaining the stated expectations and task goals. My findings support the use of cognitive tools and intellectual roles promoted by Palincsar and Herrenkohl (2002).

Section Two

In this section of the chapter I discuss selected key findings in relation to the instructional, activity, and report writing / whole class discussion phases of the lessons. I start by discussing the instructional phase of the lessons with a particular focus on the following: the assumptions made by the teacher about the students' prior knowledge of the concepts she

had selected to teach; their understanding of the procedures for carrying out the assigned tasks; the length of the instructional phases; and teacher and student questioning. This is followed by a discussion of the activity phases of the lessons in relation to teacher monitoring of student behaviour and concept understanding, and the teacher and students' focus on task management and presentation. I then discuss my findings in relation to the report writing / whole discussion phases of the lessons.

Instructional phases of lessons

My findings demonstrate the importance of the instructional phases of lessons in relation to student understanding of the concepts selected by the teacher and on their understanding of the task requirements. It is during the instructional phases of lessons that teachers establish their goals and expectations of student performance of the task. The way that teachers use the instructional phase of lessons to present tasks, and the amount of detail provided of how the task should be presented is important for the way it is shown to influence student preference (Nuthall, 2000).

The instructional phases of the selected lessons reflected a transmission model of teaching rather than a constructivist approach. In the Aztec question writing lesson, the instructional phase was largely dominated by the teacher with limited opportunities for students to ask questions. The instructional phase of the pop-gun and boat lesson is best described as fragmented and subject to change depending on the way the teacher was able to manage the discussion and behaviour of the students.

An important finding was the extent to which the teacher based the instructional phase of the Aztec question writing lesson on her assumptions about the level of the students' prior knowledge and understanding. It was clear to the teacher from the very first lesson that none of the students in the class had any prior knowledge of the Aztecs. The teacher then spent the first week of the unit attempting to provide a meaningful context for the study. As she stated at the conclusion of the unit:

> "I was a bit worried at the start of the unit with the lack of enthusiasm and things right at the beginning. I thought maybe I'd chosen the wrong topic. Just that they didn't know anything about the topic at all ... which is probably against everything that we should probably be teaching. Normally you hang it on some sort of prior knowledge. But starting from scratch...with those kids you can get away with it, having a brighter class."

The teacher's comment is evidence of the assumptions she made in relation to student ability. In spite of her understanding of the importance of prior knowledge on interest and understanding, the fact that the students were considered to be of high ability justified her belief that she could "get away with it". The teacher's assumptions were not supported by the findings. There were examples of students like Rewa and Libby who were unprepared to

demonstrate their lack of understanding by not putting their hand up to seek clarification, or by using non-verbal forms of communication to indicate they were coping with a task even when they were unsure of the requirements or were experiencing difficulty.

Length of the instructional phases of lessons

My findings demonstrate the significance of the length of instructional phases of the two lessons on student attention. The instructional phase of the Aztec lesson took 26 minutes of the 53 minute lesson. The instructional phase of the pop-gun and boat lesson (including the time taken to give instructions for writing the report) took 20 minutes of the 49 minute lesson. Due to the excessive length of the instructional phases of the lessons, the students lost focus and engaged in high rates of off-task behaviour. This behaviour was particularly evident in the pop-gun and boat lesson where the teacher issued a total of 49 reprimands or requests for students to pay attention. As a result, the instructions for the tasks became fragmented and difficult to follow.

The need for students to pay attention during the instructional phases of lessons is fundamental to their subsequent understanding of task requirements. As proposed by Erikson (1996) there is a need to 'go for' critical moments in the discourse, both attentionally and in uttering. As perceivers and thinkers we have severely limited information processing capacity at any given moment, and participation in face-to-face interaction provides us with far more potential information than we can handle perceptually and cognitively. This raises important issues in relation to whole class instructional phases of lessons where attention in groups of interlocutors needs to be focussed collectively at certain moments if they are to understand what is going on. Erikson argues that the collective organisation of attention would seem to be necessary for the whole group to learn: that is, if more than one pupil is to get the information available at a given moment, the attention of more than one student must get to the same moment.

My analyses show that collective attention does not occur in a class of 30 plus students, therefore many students miss out on critical information necessary for understanding related concepts and for carrying out the task. Illustrative were the conversations that were going on among groups of students while the teacher was attempting to provide instructions for the pop-gun and boat tasks. Over a 1.5 minute segment of the instructional phase, the teacher made 14 requests for students to pay attention to what she was saying. During the same 1.5 minutes, Jack and his friends were completely ignoring the teacher's requests and were carrying on a parallel conversation about the composition of their group and the resources for the experiment. In total, Jack managed to talk to his peers on 22 occasions during the instructional phase of the lesson when he was supposed to be listening.

Clarity of instructions for tasks is shown to have a significant effect on student understanding and subsequent task engagement. When instructions were fragmented, or lacking in clarity, students became confused or lost focus. When written instructions were either too lengthy or complex, the students would not read them. Conversely, if written instructions were too brief, student understanding was compromised. When instructions were not explicit, students had opportunities to interpret the instructions to match their own interests and task goals that may have been different from the teacher's.

When students are unsure of the requirements or expectations of the task, or when the task lacks relevance or appeal, they may 'subvert' it, suggesting that instructional phases of lessons should be used to provide students with clearly stated goals and expectations of tasks. A fuller discussion of findings related to the discourse of the classroom is provided in section three of this chapter.

Teacher and student questions

Consistent with constructivist perspectives, an important part of the instructional phase of a lesson is the opportunity for students to be able to ask and answer their own questions in order to become active participants rather than passive observers in the learning process (Newton, 1999). As demonstrated in the following excerpt the teacher of the Aztec and Kitchen Chemistry units gauged student interest by their interactions and the number of questions they asked.

Interviewer: How do you get feedback on whether the children are interested? What are the indicators that you as a teacher register to yourself to confirm that the children are interested?

Teacher: For me it's their interactions with others. The talk between other kids, the questions, if they're questioning. If I can get alongside...ask how are things going? The interactions that you have in that way, they're the most valuable because you're giving the feedback to the kids.

While the teacher was generally effective in her questioning with individual students during the activity phase of the Aztec unit, the majority of questions she asked the students during the instructional phase of the lesson were non-content related. My findings show that the instructional language and the teacher's and students' questions focused mostly on procedures for carrying out and presenting tasks rather than on content and conceptual understanding. In the Aztec question-writing lesson, the teacher asked only two questions related to content. In contrast, she asked 13 questions related to student understanding of the procedures for setting out their questions.

The teacher's practice was consistent with the literature that provides substantial evidence that teachers continue to ask most of the questions, and that the questions that they ask are often related to procedural rather than content matters (McGee & Fraser, 1994; Burns & Mayhill, 2004). Students rarely focus on the content goals of classroom tasks (Anderson, 1981). Rather they ask implicit questions about how to do a task, whether they can do it, and if they want to do it. Similarly, when the students did ask questions, the majority of questions they ask reflect the same type as those asked by the teacher. The students in the same lesson asked a total of three content-related questions and 17 questions related to procedures for carrying out the task.

Answers given by teachers are important as they influence students' perceptions of the task, the purpose of it, their understandings of the procedures required, and their interest in completing it (Blumenfeld, Mergendoller & Swarthout, 1987). The teacher's answers to individual students' content-related questions during the activity phases of the two lessons were mostly specific. In contrast, the answers given by the teacher to the students' questions in whole class discussions were often general and of limited use in assisting student understanding or in clarifying their misconceptions. For example, in the instructional phase of the pop-gun and boats lesson, the teacher responded to 15 of the 22 answers given by students by stating 'thank you'. The word 'yes' was used three times in response to students' answers, once to acknowledge a correct response, once to acknowledge a partly correct response, and once in response to an incorrect answer. As a result, the students had little indication of the extent of their understanding or misconceptions.

The superficial nature of some of the questions asked by the teacher and subjects raises a number of issues for consideration. Is the superficiality of students' questions really a reflection of what they know and understand about the task – that is, their understanding of task presentation and not the concepts (Anstey, 1993)? Are their questions a deliberate strategy to deflect the teacher's attention away from their lack of understanding of the content? Similarly, are the teacher's general responses a way of avoiding having to deal with students' misunderstandings of the concepts (Borasi, 1990; Ball, 1991; Tobias, 1993)? Alternatively, are they a reflection of the teacher's limited knowledge of the cognitive and utilitarian aspects of the tasks, skills, and processes they are teaching (Anstey, 1993)?

As demonstrated in the following excerpt, the teacher in my study was very open about the concern she felt about the limited extent of her own knowledge, particularly in science. In relation to the Kitchen Chemistry unit she stated:

> The kids came out with different ideas from what I expected every now and again...And then the challenging of my scientific background. And saying, I don't know the answer to that, I'll have to go and find out. Or is what I've said actually a fact or have I just fed a whole lot of rubbish to the kids! ...I didn't really think about it much until the end and then I thought, oh, I hope I haven't misguided anybody hugely. But I think we got the scientific concepts over and so that was the main priority.

The teacher's comments demonstrate the challenges faced by general classroom teachers who are required to teach specialist subjects such as science to classes of high ability students who may contest the teachers' knowledge.

Activity phases of lessons

My findings demonstrate a number of important aspects of teachers' practice during the activity phases of lessons. In this discussion I focus on issues related to teacher monitoring of student activity, and the preoccupation of both the teacher and students with task presentation over content.

During the activity phases of lessons, the teacher's primary task is to monitor student compliance with task instructions, and their understanding of the content. Effective teacher monitoring is dependent on the way the teacher plans and manages tasks, and on the time allocated to ensure all students can be monitored.

When interviewed about the Aztec unit, the teacher stated:

> "I think they've taken on a bit more responsibility. I mean, there were sessions there that I didn't even need to be there. I felt totally useless really. Because, I mean, I went around and interacted but I didn't actually need to be there, especially when they were just getting themselves organised and they were all focussed and totally knew what they were doing. And I was amazed, you know, I looked around the room at one point and I thought I don't even need to be in the room. I went for a wander outside and then sort of came back in and they were still focussed on what they were doing."

The teacher's perceptions of the subjects' efforts during the activity phase were inconsistent with the data. As reported in Chapter 6, Ned and Rewa exhibited high rates of off-task behaviour. While Rewa appeared to be focussed when writing her questions, much of what she was writing was copied from books, or involved copying the questions generated by the teacher and student teacher from one piece of paper to another. When she worked on her poster in subsequent lessons in the unit, Rewa's focus was not on the content but on the decorative border she drew. When asked about her contribution to the poster, Rewa confirmed that she did a "little bit of writing" but that she "mostly decorated it." Libby's comments

show that she did not enjoy the unit. "I hated what I was doing, that research stuff. When I was doing the research preparation, the time went slow. I felt bored...I have no idea why the teacher wanted us to do the research presentations. I did it because she asked me to."

When discussing her evaluation of the Aztec unit, the teacher saw the need to continue developing the students' research skills but added "I think I've got all of them away from writing out of a book...to ask your own question and actually put it in your own words...what does it mean to you and what's it going to mean to someone else reading it." The data show that all four of the subjects had presented limited information on their posters and that most of what they had written was directly copied from the resource books or from material downloaded from the internet.

My findings suggest that teacher monitoring of student understanding and compliance with instructions for tasks needs to be focussed and on going for all students, but is particularly important for low achieving or less confident students. The data suggest that there is a critical point at which students will either persist with, or abandon a task. Once a teacher is sure the student understands the instructions for initially undertaking the task, on-going monitoring is essential in relation to students being able to proceed with subsequent steps in the task. Teachers spend considerable time gathering resources and planning lessons that will interest and engage their students in the concepts they have selected to teach. Unfortunately, much of this high energy activity is often unproductive in terms of learning outcomes for students. In a National Radio interview (21 Feb. 2004), Nuthall stated that a fundamental problem with teaching is that even when teachers are successful in motivating students to engage in tasks, "they don't go that bit further which is to find out whether they understand what is going on, and whether they are actually learning from it or not."

Activities that had the potential to be successful for teaching selected concepts were often regarded by students not as part of the learning process, but simply as activities to be completed as quickly as possible, with as little effort and as much fun as possible. Illustrative were the students' attitudes towards the chemical pop-gun experiment. They were not interested in the concepts embedded in the task, they simply wanted the "bang" at the end. The teacher understood their approach as evidenced in her comments about the lack of additional learning that would have resulted from the students repeating the pop-gun experiment several times.

The teacher's comments raise two questions. When the teacher knew that the students would not be learning anything after their first experience of the task, why did she not insist that they

engaged with the second experiment she had planned for them to complete in the session, rather than allowing them to repeat the pop-gun experiment several times? The most obvious explanation is that the teacher was so preoccupied with safety concerns and managing the students' behaviour that she was unable to insist that they undertook the boat activity. She had also received many negative comments from students who had been assigned to the boat task and would have realised that she would have created additional management problems if she insisted that the students undertake the less desirable task. Second, how could the teacher be sure that the students had learned the related concepts after their first attempt when the data shows that the majority of her time had been spent trying to manage the students' behaviour, both in the instructional and activity phases of the lesson? The content of the subjects' written reports and the post-test results show that the teacher's perceptions of what they had learned were inconsistent with the data. This discussion is not intended as a criticism of the teacher's practice but confirms the difficulty faced by teachers in managing large numbers of students. My findings support Nuthall's (2001) assertion that even the most aware teacher cannot monitor the behaviour or understanding of 30 plus students simultaneously.

Teacher and student preoccupation with task presentation over content

An important finding was that of teacher and student preoccupation with task presentation over content. As evidenced by the analyses of teacher-student task related interactions in Chapters 5 and 6, the primary focus of both the students' and the teacher's questions during the instructional phase of the Aztec lesson was on procedures for presenting the work rather than on the content. As demonstrated in the following excerpts, when asked to evaluate their work, the subjects placed a premium on its appearance.

I: How did you feel about your poster?

Libby: It looked okay, but yeah (laughs). Oh it wasn't very creative because we usually do the same thing like that. Sometimes you forget what you're supposed to be doing and you carry on with your poster but there's hardly anything to do and you just add all these bits.

Ned: We weren't really pleased with it (the poster)...just the colour of it sort of.

Jack was particularly concerned with the standard of his own handwriting and preferred to use the computer to present his work.

I: Was there any work that you had to do that you really didn't enjoy?
Jack: Doing all the writing...My writing's not very good.
I: Do you mean not very good in what you write or how it looks?
J: How neat it is.
I: How could you present your work?
J: Write it down on the computer so it looked neat.

I: What is it about other people's work that makes you remember it?
J: It looks neat. The pictures and all that.

In an attempt to encourage the students to take a deeper approach to evaluating their own work and that of their peers, the teacher had implemented a peer evaluation procedure referred to as PMI (plus, minus, and interesting). In the post-unit interview conducted with the teacher at the conclusion of the second unit, she mentioned the improvement in the way many of the students were focussing more on the factual information in their peers work. "That's what we've been sort of hammering all year, get it based on factual information. It's not just the pretty pictures." The teacher's observations were supported by some of the subjects' interview comments that demonstrated a greater focus on interesting information, although presentation was still a consideration.

I: What did you look for in the Aztec research presentations?
Rewa: I looked for really interesting things they said...I think the posters need to be a bit colourful... they've got to stand out and grab your attention.
Rod: Some of the posters were interesting and some were boring. The interesting ones were the ones with the good facts.
Ned: I looked for information that I thought was interesting...I'd just think a bit about the presentation and colouring...I was a bit ashamed of how our poster turned out... how much information was on there cause there wasn't a lot.

Consistent with the literature, my findings demonstrate that teachers and students often focus on the superficial aspects of tasks, rather than on the content (Corno & Rohrkemper, 1988; Kohn, 1985; Nuthall, 2000) and suggest that by Year 5 and 6 some students may have learned that they can meet task requirements knowing that their work is likely to be monitored mainly for presentation rather than content.

My findings raise the issue of the extent to which we have developed a culture that bases judgements about quality on neatness and presentation. Students appear content to focus their time and energy on decorating their work – it is easier to make it look good than to make it read well. It is also more manageable for busy teachers with responsibility for large numbers of students to check a piece of work for the standard of its presentation than to read and mark it in depth.

Report writing and final discussion phases of lessons

In order to determine student understanding of lesson content, it is common practice for teachers to plan a short concluding activity or whole class discussion of what has been covered. Palincsar and Herrenkohl (2002) reported the importance of reporting phases in

science lessons as a time when students share, compare, refute, or concur with each other's findings.

In the two selected lessons, the report writing and final whole class discussion phases were very brief. In the Kitchen Chemistry lesson, the experiments had taken longer to conduct than the teacher had planned. The teacher was left with only 5.25 minutes to give instructions for the writing activity, monitor the students writing, select students to read their sentences, and conduct a whole-class discussion of their findings. The students had 3.5 minutes to write two sentences about new things they had learned during the lesson. When some students called out that they couldn't think of anything they had learned, the teacher referred them to the diagram she had drawn on the board to demonstrate saturation. Some of the students subsequently copied the teacher's information. All four subjects managed to write one or two sentences with three of them writing about saturation. As there was insufficient time to conduct the whole class discussion as she had intended, the teacher had limited opportunity to gain an understanding of the students' learning. The students' books were not collected in for marking so any misconceptions they may have had could not be corrected before the next lesson.

In the Aztec question-writing lesson, 4.25 minutes was allocated for whole class discussion and for students to share their open and closed questions. Four students were selected to read their questions to the class. In spite of the fact that none of their questions were open questions, the teacher acknowledged them positively, indicating that they were correct. The teacher specifically requested that all books were handed in so she could check their questions before the next lesson. Ned did not hand his work in to be marked and the teacher did not indicate that she had noticed.

My findings demonstrate the need for teachers to allow adequate time for conducting the important final phases of lessons. Report writing and whole class discussion phases at the end of lessons afford valuable opportunities for students to demonstrate and consolidate their new understandings and provide the teacher with a base from which to plan, or adapt, the content of subsequent lessons.

Section Three

In this section I discuss key findings related to classroom discourse. This is followed by a discussion of the significance of classroom culture and the unique ways that selected subjects experienced the classroom. The section concludes with a discussion of the challenges faced by the teacher in incorporating constructivist principles into her practice.

Classroom discourse

Classroom discourse has been included in this discussion because of the prominent role it plays in shaping students' beliefs and understandings of subject matter, and the effects that discursive practices have on student participation in the public and semi-private domains of the classroom. First I draw on the literature to establish the significance of classroom discourse. I then discuss the influence of selected aspects of the teacher's and subjects' behaviour related to classroom discourse. This includes a discussion of the following: the effects of teacher assumptions on student participation in classroom discourse; opportunities for students to be active participants in classroom discourse; teacher awareness of students' semi-private interactions; teacher monitoring of student understanding, and the teacher's awareness of the differences in the way that individual students participate in the discourse of the classroom.

The significance of classroom discourse is well established in the literature (Schwab, 1954; Romagnano, 1994; Heaton, 2000; Crespo, 2002). Those who adopt a socio-cultural approach to curriculum acknowledge the role of language in mediating the construction of communities with shared discursive practices (Rowell & Ebbers, 2004). Classroom discourse is different from everyday conversation because it is framed and shaped by pedagogical purposes and the power differential between teacher and students and by the pervasive power of the "clock and the crowd"(Anderson, 2000, p.392).

When effectively managed, classroom discourse offers opportunities for students to be highly interactive, enhances higher-order thinking (Palincsar, 1998) and tends to promote student achievement (Hall, Allan, Dean & Warren, 2003). Consistent with constructivist pedagogy, the development of intellectual communities and the value of scaffolding student discussions to advance their ability to co-construct theories and models is advanced (Herrenkohl & Wertsch, 1999). Alton-Lee (2003) accentuates the need for teachers to focus on questions that are planned to engage students in sustained discussion, structured around powerful ideas. Palincsar (1998) emphasises the importance of the teacher's role in mediating classroom discourse by introducing new ideas or alternatives into the conversation that will extend the students' thinking and prepare them for conversation.

The effect of teacher assumptions on student participation in classroom discourse

An important finding in relation to classroom discourse was the effect of the assumptions made by the teacher about students' prior knowledge and understanding of what she had selected to teach. This was particularly evident in the instructional phases of the lessons and during whole class discussions. During the instructional phase of the Aztec question-writing lesson, the teacher made eight major assumptions in relation to what the students should already have known about the content of the lesson and the requirements of the task. Only the

most assertive or confident students appeared to be prepared to challenge the teacher's assumptions or to seek further clarification if they were unsure of the teacher's meaning.

The teacher's assumptions were found to limit the extent to which less confident students were prepared to risk exposing their misunderstandings to the teacher and peers, particularly if the teacher had indicated that the concept being discussed or the question being asked was easy and that all students should understand it. Libby and Rewa were examples of more reticent students whose fear of ridicule and low self-confidence constrained their participation in whole class discussions (Wilen, 2004). In the post-unit interview Libby was asked about her willingness to raise her hand during whole class discussions. Libby stated: "I usually don't put my hand up, just if I'm sure about something I'll put my hand up. But if I'm not, I never put my hand up... I wouldn't want to be totally wrong, it would embarrass me." Similarly, Rewa reported to only raise her hand if she was confident her answer would be correct. Rewa stated: "Sometimes I don't understand...If you made a mistake, well sometimes it could be embarrassing or something, and sometimes its just an easy mistake."

The teacher demonstrated her awareness of individual students' hand-raising behaviour. Illustrative are the comments the teacher made about Rewa's hand-raising behaviour in the following post-unit interview extract. "Rewa's very quiet anyway, but whenever she puts her hand up ... you know, she's one of those kids you think, oh she's got her hand up, ask her." Out of sensitivity for Rewa, the teacher did not pressure Rewa to raise her hand, preferring to select her to respond when she did volunteer an answer. As a consequence of the teacher's awareness, Rewa knew that if she put her hand up, the teacher would probably ask her to respond. She was therefore unprepared to raise her hand unless she felt sure she knew the correct response. As discussed in Chapter 5, Rewa avoided the possible embarrassment of making "an easy mistake" in front of her peers or the teacher through the use of non-verbal communication. By maintaining silence, or nodding in response to the teacher's questions, Rewa knew that the teacher would eventually answer her own questions, providing her with the information she required to continue with the task. It may be concluded that the teacher and Rewa were aware of how they each responded in the public forum of the classroom and had developed ways of interacting that were mutually acceptable. It is argued, however, that valuable opportunities for Rewa to cognitively engage with the concepts or to have misconceptions corrected may have been limited as a result.

Opportunities for students to be active participants in classroom discourse

In spite of the evidence of the benefits to students when given opportunities to be active participants in construction of knowledge through active participation, classroom practice and discourse are still embedded in positivistic and transmissive perspectives (Burns &

Myhill, 2004). Teacher domination of classroom discourse is still evident in many classrooms and is resistant to change (Crespo, 2002). When the teacher acts as the authority, the students' imposition of their own relevance outside of the teacher's frame of reference is limited, resulting in low-level student questions and statements (Moroz et al., 2000). Teacher domination limits opportunities for students to show initiative, control the direction of discussion, or contest the teacher's prerogatives Yip (2004).

In the post-unit interviews the teacher had mentioned the importance of students being able to be active participants in whole class and group discussions, and that she gauged student interest and understanding by their questions. Consistent with the literature, my findings demonstrated that the teacher dominated the discussion during the instructional phases of the two lessons. Illustrative is the instructional phase of the Aztec question-writing lesson where the teacher was the only person to be talking for 20.25 minutes of the 26 minutes. The time available for whole class discussion when students were able to answer teacher questions related to content and procedural matters, and to seek clarification of the task requirements was limited to a total of 5.75 minutes. Similarly, in the science lesson involving the pop-gun and boat experiments the teacher was the only person talking for 13.5 minutes of the 18.25 minute instructional phase.

An additional finding related to the disproportionate number of opportunities afforded some students to participate in whole class discussions. Support for involving all students in discussion lies in the purposes and elements of constructivism, and the need for all students to be active participants in classroom discussions is well established (Hall et al. 2003; Wilen, 2004). Although 13 of the 28 students interacted with the teacher on a total of 25 occasions during the 5.75 minutes instructional phase of the Aztec question writing lesson, the interactions were extremely brief and were dominated by two students who between them accounted for 13 of the 25 interactions.

The most common way of responding in the classroom was for the students to raise their hand and wait to be selected by the teacher. It is acknowledged that in most cases all students had equal opportunities to raise their hand and bid for the teacher's attention. As previously discussed, the extent to which the subjects were prepared to do so depended to a large extent on their confidence in their ability to respond correctly, especially when the question had been prefaced by an assumption that it was easy or that all students should know the answer. Once they had raised their hand it was up to the teacher to select who was to respond.

My findings demonstrate the contrast in the opportunities two of the subjects (Elle and Jack) had to respond to the teacher's questions. Confident, high achieving subjects like Elle exhibited high levels of hand raising behaviour. Elle successfully engaged with the teacher on

five out of ten attempts to respond to content-related questions during the Kitchen Chemistry lesson. Because of her demonstrated interest in the lesson, Elle was selected to organise her group's resources for conducting the experiment and was able to play an active part during the activity phase of the lesson. In contrast, during the same lesson Jack raised his hand in response to content related questions on 15 occasions and was only selected to respond twice.

Some students who were unsuccessful in their bids to interact with the teacher found other ways of satisfying their need to demonstrate their knowledge. During the instructional phase of the Kitchen Chemistry lesson, Jack engaged in high rates of self-talk with comments like "That's not right", or "I knew that" as a way of confirming his own knowledge when not asked to respond to the teacher's questions. Alternatively, Jack would engage in whispered conversations with his peers, often contradicting what was being discussed by the teacher and selected students. Jack was also prepared to risk being reprimanded by calling out answers instead of waiting to be selected.

As evidenced in the following excerpt, the subjects were aware of the differential treatment of individuals by the teacher, particularly during whole class discussions.

Interviewer:	Does everyone get the same opportunity to answer the teacher's questions?
Ned:	Not really, like Anton and Carly ... oh, just sorta, um, because they put their hand up, well Miss H actually chooses them more often.
I:	Are there some people that wouldn't put their hand up at all?
Rod:	Yeah, some people wouldn't be bothered putting their hand up ...maybe cause they don't know the right answer, or maybe cause they can't be bothered.
I:	Do you often put your hand up and have to wait and not get asked?
R:	Yeah, probably all the time.

These examples raise a number of issues for consideration including the effects of teacher behaviour in relation to student hand raising on a student's motivation to respond, the effects on their social status, and the influence on a student's decision to either conform to or ignore established classroom protocols for participation in whole class and group discussions. My findings are consistent with those of Black (2004) who proposes that teachers' differential interactions, based on assumptions or perceptions of an individual student's ability may result in self-fulfilling prophesies for students and the perpetuation of social hierarchies. It is argued that Elle and the two students who between them interacted with the teacher on 13 occasions during the Aztec lesson were advantaged in several ways. The opportunities they had to ask and answer content-related questions allowed them to cognitively engage with relevant

concepts and to have their misconceptions corrected. Their social status within the class may have been enhanced through their contributions and interactions with the teacher in the public forum of the classroom. Selecting the same few students to respond may influence the students' perceptions of who is considered to 'hold the knowledge'. In addition, the teacher's understanding of the students' prior knowledge and understanding is limited to the responses of only a few.

Teacher awareness of the differences between individual students and their participation in the discourse of the classroom

My findings show that the teacher was aware of the differences between individual students in relation to their participation in the discourse of the classroom. In the Aztec question writing activity the teacher was conscious that one of the students who was new to the class required additional support with instructions for writing his questions. The teacher was also aware of one of the girls who lacked confidence in responding to or asking questions in a whole class situation. The teacher made a point of spending time with her to ensure she understood the requirements. When it was clear that the student needed time to think before responding, the teacher sensitively turned her attention to other students before resuming her conversation with the girl.

The teacher did not pressure students to respond in the public forum of the classroom out of sensitivity for the individual. Examples have been provided of the way the teacher demonstrated her sensitivity in relation to reticent students like Rewa. There were also occasions when the teacher would try to extend some of the more confident students' thinking skills through persisting with her questions until she was satisfied with their response. Illustrative is the example of the interaction between Rod and the teacher reported in Chapter 6. Rod was a confident, able student who enjoyed interacting with the teacher and was prepared to seek clarification when required. The teacher knew that she could extend Rod's thinking by questioning him and challenging some of his responses until she was satisified that he understood the difference between an open and closed question.

On other occasions the teacher was prepared to "put the kid on the spot" in order to extend their oral skills. In the post-unit interview the teacher reported being generally pleased at the development in the children's oral skills during the Aztec unit, stating: "It's taken a long time because fairly able kids are often not very good at orally explaining things." The teacher commented on one strategy she used to develop and extend her students oral skills. The strategy involved the use of randomly asking students for their opinions. As an example, the teacher recalled the session at the end of the unit when all students were

required to present their research to the rest of the class who then evaluated their efforts. Rather than wait for children to volunteer their opinions, the teacher stated:

> "In the end I was just choosing randomly on purpose, just to try to put the kid on the spot in a different oral situation and say, well, what do you think? And occasionally the child night say I don't know. I try and leave it for a period of time until it gets too awkward and then move on, but actually give them some thinking time."

The amount of time teachers are prepared to wait for students to answer questions is prevalent in the literature (Freedman, 2000; Harris, 2000; Varrella, 2000). Concern about the limited time some teachers are prepared to wait before answering their own question is not new. Holt (1967) stated: "Teachers not only like the right answers, they like them right away, or else someone will correct it for the child" (p. 148). In the above example the teacher demonstrated her awareness of the need to provide wait time for the students to respond when randomly asking for their opinion.

Teacher awareness of semi-private interactions between students

While the teacher was aware of many of the interactions that took place in the public forum of the classroom, she could not have been expected to know the content of the students' semi-private interactions. Examples were provided in Chapters 5 and 6 of the subjects' content and non-content related interactions during the instructional and activity phases of the lessons. Although the teacher believed that most of the students were assertive enough to make themselves heard within their group, some students were considered to be unchallengeable by their peers, even when they were incorrect. In some cases their persuasive or dominant dispositions resulted in students who knew they were correct to actually change their understanding and take on the misconceptions of the dominant peer or to simply accept their verbal domination. Illustrative is the incident that occurred in Jeff's group during the pop-gun experiment as reported in Chapter 6. Jeff was aware of the need for accuracy in measuring the ingredients for the pop-guns. Another student in the group (Randal) insisted on adding more baking soda in the hope of causing a "bigger explosion". Although Jeff clearly disagreed with Randal, he was unable to verbally convince him of the need for accuracy or to control Randal's indiscriminate measuring of the baking soda. The teacher was unaware of the boys' interactions or of Randal's behaviour that caused the experiment to fail.

Consistent with Nuthall (2000), the teacher's primary concern was managing the classroom and the activity as opposed to concern for student understanding and learning. These findings are consistent with those of others as well (Brandt, 1993; Saphier & Gower, 1997; Day & Leitch, 2001).

Teacher and student interactions in relation to monitoring of understanding

An additional finding of interest related to the ways that the teacher and students responded to each other in relation to monitoring of understanding. Evidence suggests that the teacher and the students had learned to play a mutual game of providing the answers each wanted to hear. This appears to be particularly true of interactions between the teacher and lower achieving or less confident students like Rewa. There were numerous examples of the teacher asking such students how they were getting on with an activity. Frequently the students would give a very general response such as "Yeah" or "Okay" even when they were struggling with the task. The teacher would appear satisfied and would give a similarly general response or would repeat the student's words for example "Yeah, good".

There are two possible explanations for the teacher and students' behaviour. Giving the teacher a positive response reduced the risk to students of showing their lack of understanding in a public forum. By providing the teacher with a positive response, the teacher was less likely to make additional demands on the student. Similarly, demands on the busy teacher were reduced if the student appeared to know what to do. Regardless of their individual motives, such practice is not considered conducive to enhancing student understanding or work output, or giving the teacher an accurate measure of the students' understanding.

In contrast, there were some examples of quite sophisticated levels of teacher-student interactions including the occasional judicious use of humour and sarcasm that was accepted by both the teacher and students. Illustrative is the following brief exchange between Ned and the teacher during the Aztec study. Ned had been struggling to get ideas for writing his questions and he had been unsuccessful in his attempts to interact with either the teacher or his peers. It was the teacher's first interaction with Ned during activity phase of the lesson and it occurred two minutes before the end of the 22.75 minutes allocated for the task.

Teacher : What are you doing, warfare? Surprise, surprise!
Ned: Aztecs, maybe I'm bored!

The conversation then quickly proceeded to the questions Ned had managed to write. Both Ned and the teacher knew it was as far as their exchange needed to go. Ned was satisfied that he had been able to let the teacher know how he felt, and the teacher was not prepared to discuss Ned's boredom. The teacher appeased Ned later by letting him read his question to the class, thus maintaining the understanding that had been established between them.

In the post-unit interview the teacher commented that the students were able to cope with a more sophisticated level of interactions because of their high ability. As demonstrated in the following extract, the teacher aimed to run her class in ways that would encourage interaction and be supportive of students' expressing their opinions. "Because of the way the classroom's run there's a certain amount of interaction between the kids that's quite humorous and that sort of thing. And there's a bit of interaction.... And OK, if you've got an idea or an opinion, you come up with it."

In summary, my findings demonstrate the complex nature of classroom interactions with classroom talk being orchestrated and managed by both the teacher and the students. As proposed by Anderson (2000): "To manage classroom talk is to orchestrate events, people and time, as well as knowledge, understanding and learning" (p.393). It is acknowledged that the way in which a teacher manages the social interaction system significantly influences the culture of the classroom and the opportunities afforded to students to be active participants in the learning process. My findings also support Nuthall's (2000) contention that in the context of the busy classroom teachers are only aware of what they can see and hear. Much of the conversation that occurs between students is inaccessible to the teacher. While teachers may appear to 'control' and dominate classroom discussions, the teacher is not the only influence. The power of the peer sub-culture exerts a significant influence in all aspects of classroom life. Hess and Posselt (2002) found that even when teachers had set goals of achieving some higher level of equality in classroom discussions, their goals were under-cut by influences over which they had little influence or control.

Significance of classroom culture

One of the most illuminating findings in relation to furthering my own understanding of the classroom was the unique way that each subject experienced the culture of the classroom, reflecting the individual's identity and social positioning (McLaren, 1995). Classroom culture used to be regarded as fixed, something that was established by the teacher and experienced in the same way by all students. It is now widely recognised that classroom culture is not just established by formal school rules or those only elaborated by the teacher, but through the micro-politics of the classroom and the power relations inherent in it (Allard & Cooper, 2001). Post-structural theorising examines power relations as on-going, dynamic interactions played out among all participants (Foucault, 1980; 1982; McLaren, 1991).

While the culture of the classroom is strongly influenced by the teacher, students also establish classroom sub-cultures in relation to social and academic hierarchies, and their interpretations of how the classroom operates. The teacher may be aware of some of this peer sub-culture but much of it operates covertly and is therefore largely unnoticed by the teacher.

There was a marked variation between the subjects in my study in relation to the characteristics they displayed as learners and participants in the classroom community. These characteristics may be broadly classified into two categories: characteristics that relate to the student's own skill and knowledge, and characteristics related to other aspects such as confidence, self-esteem and motivation. There is evidence of a strong relationship between the two areas.

As demonstrated in previous discussions, due to the existing social hierarchies and the assertiveness of other students Beth was excluded from actively participating in her group's pop-gun experiment. Beth has learned that science can be exciting "when you get to have a go". She has also learned that "you have to be patient" when waiting for a turn, and accepting of the fact that she might not get one. In contrast, Elle's greater confidence and assertiveness enabled her to take a prominent role within her group and to successfully engage with the teacher on several occasions.

There are strong similarities between Beth and Elle's experience of science and that of the two subjects in Sahlstrom and Lindblad's (1998) Swedish study of the difference in two Grade 8 and 9 girls' interactions with their peers, teacher, and artefacts of science. Like Elle, one girl was from a powerful social group, was successful in her bids to gain the teacher's attention, took an active part in the science experiments, and enjoyed a high profile within the class. The other girl was like Beth. She was from a lower socio-economic group, did not bid for the teacher's attention, and engaged in science tasks minimally. Sahlstrom and Lindblad concluded that "Science for the two girls seemed to be a lot less and a lot more than what one traditionally means by the concept" (p. 210), and that 'discovery learning' is not always a discovery of scientific facts but of issues such as social creativity and opportunities for identity construction.

The power of the peer sub-culture should not be underestimated. Peer sub-cultures can support and enable learning. Conversely, the power of peer sub-cultures when it involves bullying and power abuse may subvert learning (Alton-Lee, Nuthall & Patrick, 1999). Nuthall (2001) suggests that children live in their own world within the classroom, and that how peers evaluate their behaviour is more important than the teacher. Despite the teacher's rules or active promotion of inclusive activities, sexism and racism can flourish.

My findings have illuminated many of the ways that the culture of the classroom significantly influences the different ways that individual students experience the classroom. Educators stress the need for teachers to be aware of the significance of culture in the classroom. It is worth repeating Nuthall's (2001) warning:

> One of the most significant things about culture is that it becomes so much a part of ourselves that we can no longer see it for what it is. The more familiar it is, the more it is like the air we breathe, the harder it is for us to see it...So long as we are unaware of the extent to which culture determines how we practice and think about teaching, we will remain locked in a system that inevitably produces failures and inequalities (p. 1).

Challenges to implementing constructivist principles in classroom practice

Research conducted over the last two to three decades has resulted in widespread acceptance of constructivist and socio-cultural perspectives on teaching and learning (Nuthall, 1999). The extent to which a teacher subscribes to constructivist and socio-cultural perspectives determines their perception of their own role in the teaching-learning process, and the extent to which they are prepared to empower students by including them in classroom decision-making processes.

As reported in Chapter 7, the teacher of the Aztec and Kitchen Chemistry units articulated the benefits of implementing her practice based on constructivist principles. Consistent with Niemi (1999; 2002) the data reported in Chapters 5 and 6 demonstrated the limited extent to which constructivist principles were actually applied in the teacher's practice. This is not a criticism of the teacher. Rather, it is a reflection of the challenges faced by teachers who subscribe to constructivist principles but are constrained from implementing them in their classroom practice for a variety of reasons. The teacher in my study was genuinely concerned about the constraints that she felt inhibited her from teaching in her preferred way. She specifically mentioned constraints of the National Curriculum, lack of time, limited resources, Education Review Office reporting and assessment requirements, the effects of other teachers' transmissive practice on her students independent work habits, and unrealistic parental expectations. The teacher was most concerned about having to compromise the quality of student learning in order to cope with these constraints while having teaching responsibility for 30 students, each with diverse interests and needs.

Nuthall (2004) agrees that because of the way the current education system is run, teachers don't have the time to teach the curriculum in any depth. Nuthall does not consider, however, that the problem is insurmountable. As a starting point, in order to reduce the haphazard way many students currently learn Nuthall asserts that teachers need to take the time to unpack the curriculum and select those concepts that they consider to be of real importance. Once the students have a basic understanding, the teacher may then teach something else, confident that there is at least a foundation of basic knowledge to build on.

While the teacher's concerns about the constraints on her practice were well founded and did impact negatively on her practice, the implementation of constructivist practice is more complex than simply increasing resources. According to Saphier and Gower (1997), the implementation of constructivist pedagogy requires a paradigm shift for teachers. Windschitl (1999) suggests that constructivist practice may pose a threat to some teachers who fear they might lose their power and control in the classroom. According to Windschitl, while teachers may implement some constructivist practice in their classrooms, they are often just isolated activities. Windschitl argues that such practice does not go far enough, and that there is a need for an all-encompassing constructivist classroom culture.

Niemi (1999) asserts that while teachers may want to apply active learning methods consistent with constructivist pedagogy, they do not feel they have the time, energy, or in many cases, the prerequisite skills and knowledge to implement them. These assertions raise a number of questions for further consideration. To what extent are teachers really committed to constructivism? Are the demands of implementing and sustaining a constructivist classroom really too great within the constraints of the current educational system? Importantly, how well do teachers really understand constructivism? In Chapter 9 (Section One) I suggest some ways that teachers who subscribe to constructivist principles may be supported in their efforts to implement them in their classroom practice.

Section Four

Challenging conceptions and misconceptions about teaching and learning – the illusions and delusions of schooling

As a former teacher with 25 years classroom experience, participation in the Project on Learning has challenged my understandings of the teaching–learning process in significant ways. There are a number of reasons for this. In the introductory chapter of this thesis I acknowledged with some reluctance, how little understanding I had of the individual learners in my classroom, or of the effects of my practice on their learning. My time was spent attempting to manage the hectic life of the classroom with teaching responsibility for up to 40 students at a time. With experience I became adept at using strategies that helped to give me the appearance of being a 'good' teacher with my busy, active students and their colourful work displayed within attractive borders on the classroom walls.

There was no culture of asking children about classroom experiences or their opinions about teaching and learning. If they happened to tell me they were bored I would see it as the child's problem, not mine. How could my classroom programme possibly be boring when I'd spent all my weekends and holidays preparing and photocopying 'interesting' activities for my

students? Besides, the principal was happy, the school inspectors were complimentary in their reports, teachers' colleges sent me their trainees, and the parents were happy with the positive comments I wrote on their children's reports (I had a philosophy of finding at least one positive thing to say about every child!) We even used to joke in the staff room about the covert meanings behind some of the comments we wrote on reports. We knew the parents would interpret "Jack is trying" in a positive way. What we really meant was Jack was trying our patience, our sense of humour, and above all, our capacity to manage him. Perhaps Jack was really trying to tell me my teaching was ineffective!

As a result of the widespread positive perceptions of my practice, nothing changed. Why would I change practice that was perceived to be so successful? I can't recall the word 'reflective' ever used in relation to my practice. Evaluation was something we did routinely at the end of each year in order to comply with the requirements of the school scheme. Once every three years when it was our school's turn for a visit from the inspectorate, we would conduct a school-wide evaluation. We were being evaluated on our successes, and because everything was going so well our evaluations were always positive. Clearly we had no real problems, or least none that we were aware of.

I now realise that despite the extraordinary time and effort that my colleagues and I put into our teaching, the majority of our efforts involved the maintenance of illusions and delusions about schooling. Our practice was a continuation of, and at times an extension of, our inherited culture of teaching and learning. My classroom met the criteria of the 'effective classroom' – it was brightly decorated, the students were active, and I was certainly busy.

Playing the 'game' of schooling

Based on my participation in the Project on Learning I now propose that schooling may be described as a 'game' that is played at all levels of the education system from primary/ elementary schools to tertiary institutions. I argue that when education is perceived as a 'game', the resulting focus is mostly on procedures for playing rather than on the development of content or understanding of the strategies by which to play effectively. While it is acknowledged that 'gaming' is not an entirely new idea relative to education, I assert that the extensive data and analysis procedures employed in the Project on Learning have enabled me to support my proposition of the 'game of schooling' in greater detail than is apparent in the current literature. Most existing references to 'playing the game' are in relation to the use of metaphors to describe teacher and student behaviour. Examples include: "The working lives of teachers are dominated by the demand to 'perform' effectively, with precious little

time for reflection and consultation with colleagues" (Cooper, 1996, p.76). Ramsay (1993) promotes the encouragement of children to 'perform' at their best level. Allard and Cooper (2001) propose that individually and collectively, teachers and students 'act' to achieve their own outcomes that may be different for individuals.

My argument supports and extends that of Nuthall (2000) who has nested his idea of gaming within a socio-constructivist theoretical frame that permits us to see how the game is sustained in spite of our recognition of it. Nuthall (2000) proposes that those who write from a socio-cultural perspective have defined learning as the increasingly expert participation of students in busy, active classrooms. The busy, active classroom model has developed from a very fundamental problem for teachers – they have no direct access to how the students' minds are actually interpreting and understanding classroom activities. As a consequence, teachers respond to secondary indicators of the learning process: the students' expressions, what they seem to be doing, and how they seem to be responding to an activity (Jackson, 1968). Studies from the 1970's showed that the primary cue used by teachers in judging how well an activity was going was student participation and involvement (Zahorik, 1970; Clark & Yinger, 1977). The consequence of this is the enshrinement of the busy active classroom. Forty years later little appears to have changed. Teachers' planning and evaluation of their teaching is still based on this model. "In order to avoid direct reference to the minds of students, they have idealised participation in classroom as both the end and the process of learning" (Nuthall, 2000, p.3).

Nuthall's (2000) research demonstrates that what counts as an indicator of being interested and engaged, or of knowing and understanding, can vary with the cultural background of the students and the history of their experience with teachers. Students "learn to play the reciprocal game" (p.3). This includes learning the kinds of indicators used by teachers to gauge how they are working, and whether they actually know what they are doing. In this way, students are able to manage their involvement in classroom activities with the minimum of effort and with a focus only on those tasks that are likely to be noticed and evaluated by the teacher. As argued to Nuthall (2001):

> So long as these rituals and routines are recognised by the profession and society at large as the right way to run classrooms, and students have learned to play the reciprocal roles that these routines require, then teachers' do not have to pay more than passing attention to what is going on in students' minds (p.19).

Nuthall (2000) asserts that schools are not just places for keeping students active and that the major goal of education is not the management of classroom activities, but the learning that shapes students' minds. Consequently, what matters is what students take away from the classroom. Students who learn most from their classroom experiences are not necessarily those who are the most able, but who are the most expert in the systems that determine how

classroom activities are carried out. Students most likely to succeed in the schooling system are the ones who take leadership roles in groups, who understand their own cognitive processes and understand how the teacher wants activities to be carried out. Because of their 'expertise' they are most likely to be regarded by the teacher as able and hard working and therefore likely to be rewarded. Importantly, they are the students who are most likely to select alternative activities or create additional learning experiences that will enhance their learning not only of the curriculum, but of the structures and processes that make up classroom activities. Black (2004) concurs with Nuthall, arguing that learning is not about the individual's acquisition of 'bytes of knowledge' but about learning to read the context of the lesson, behaving appropriately, using the right kind of language, and learning how to be perceived as a high ability student.

The 'game of schooling' draws players from all sectors of New Zealand's wider education community. Players include school students, teachers, principals, parents, and those in positions of authority who are perceived to hold the ultimate power in relation to curriculum design and assessment processes. Games are supposed to be played according to rules, but rules mean nothing if they are not adhered to or are established simply for the sake of doing so. The extent to which learners can 'play the game of schooling', or bend the rules depends on the teacher, the task, and their peers. Based on my analyses, I now argue that those who are perceived to have the least power, that is the students, have a greater understanding of the teaching-learning process than is commonly believed. By Year 5 and 6, students' ability to 'play the schooling game' and 'bend the rules' enables them to exert a significant influence over what actually happens in the classroom, much of which the teacher is either unaware of, or is beyond their control.

In the following section I show how the 'game' is played in the context of the classroom. I then extend the discussion to the school-wide context. Finally, I suggest that the 'game of schooling' is played at virtually every level in the education system amongst the various groups who have a part in establishing the rules of the game.

Playing the game at classroom level

At the classroom level, the 'game' is often reciprocal. In the previous discussion of the influence of classroom culture on the way an individual student experiences the classroom, I demonstrated the ways in which an individual class is organised with its unique mix of people, and ways of displaying, talking, and behaving. Classroom culture is developed in accordance with the overt rules co-constructed by teachers and students, and the more covert rules constructed among students themselves for playing the 'game', many of which the teacher is largely unaware of, or chooses to ignore.

The word 'game' is considered to be an appropriate metaphor to apply in the classroom context. Some teachers deliberately, and quite legitimately, use games as teaching strategies within their classroom programmes. My observations demonstrated, however, that many of the strategies and behaviours exhibited by the teacher and students as they interacted with tasks and with each other could be likened to a variety of games and pastimes not normally associated with learning in the context of the classroom. A game can be fun, an amusement, distraction, diversion, entertainment, pastime, play, or recreation. Games usually involve competition, contest, and at times, head-to-head encounters. Games are designed to include plans, plots, strategies, tactics and tricks. My findings provide ample evidence of the way the teacher and students participated in many of the aspects of games listed above.

At times, verbal interactions between students and teachers and students and their peers can be likened to theatre sports with the players needing linguistic dexterity, and the ability to ad-lib and improvise. Analyses of classroom discourse during instructional phases of lessons demonstrated the inability of some students to interpret the required verbal or written instructions for carrying out the activity. A student's success in being selected to answer the teacher's questions, or take ownership of essential classroom resources, is much like the card game "Snap" where the winner is the one with the quickest recall and reflexes. In some cases, students and teachers ad-libbed and improvised, often compromising understanding to avoid risk of having their misconceptions exposed in a public forum. Such situations may also be likened to charades involving pretence and parody, while the players have to guess the meaning. When that was not possible, the players reverted to mime and other forms of non-verbal communication.

The significance of cultural capital and access to resources in the classroom may be compared to the game of 'Monopoly' where those with the most resources and capital are the winners. The more strategic game of basketball where players must gain then keep possession of the ball in order to score goals has parallels in the classroom in relation to possession of the computer, science equipment or in terms of who is perceived to be the 'holder of the knowledge'. The social hierarchies that develop in classrooms can be likened to chess with its social hierarchies based on kings, queens and pawns. Any discussion of games in New Zealand would not be complete without rugby, where some would argue that ability and prowess is equated with size, weight and aggression, as opposed to skill and intelligence. There are parallels in the classroom with the assertive, domineering students who literally throw their weight around at the expense of the more reticent students. Finally, there are the comedies and dramas that depend on the skill of the actors and actresses to convince the audience of the authenticity of the plot. Most teachers will attest to feeling like actors at some time in their careers.

Players, in this case the students and teachers, may adopt a variety of roles and personas according to the game and its rules. Students can be mime artists, comics, orators, principal actors, prima donnas, understudies, members of the chorus or crowd, stagehands, or members of the audience. Alternatively, some students, particularly the low-achieving, social outcasts are regarded as intruders, interlopers, foreigners or persona non grata.

Teachers also play a variety of roles, mostly those that demand the expenditure of high levels of energy. Sergiovanni (1994) classified teachers as managers, executives, mediators, and leaders. Teachers are the directors, producers, scriptwriters, dramatists, ringmasters, virtuosos, conductors and choreographers. Teachers are also expected to simultaneously captain both teams as well as referee the game. In order to convince their audience of their talent, their roles demand that they gave performances commensurate with their external or self-appointed principal actor status.

Playing the game at the school-wide level

Teachers and students play to an audience of principals, other teachers, administrative staff, and parents. An important aspect of the game is the costuming. Some teachers demonstrate their respect by wearing their best costumes for Education Review Office (ERO) visits. Male teachers will often don their sports coat and even go so far as wearing a tie, normally worn only to auspicious occasions such as weddings and funerals. The male lecturers at teacher training institutions who are undertaking school visits to observe their trainees on professional practice are conspicuous by their attire - they're the ones in the jackets and ties. Likewise, the trainees 'dress' for their lecturers' visits. Sometimes the game is spoiled through those who do not fully understand the rules. Six year olds are very observant and are impressed when their trainee dresses up for their lecturer's visit. They wait generally until the trainee has demonstrated their ability to manage the class by insisting on a short period of silence before making their pertinent observations known. As one colleague recalls, a six year old boy pointed to the visiting lecturer and then called out to the trainee, "Why are you wearing a tie today? Only people who do real work wear ties!" Similarly, colleagues involved in accreditation panel visits from the Qualifications Authority often dress up for the occasion. Is this a part of demonstrating the quality of the qualification? Will ERO or the panel really be swayed by our standard of dress or is it all part of the elaborate 'presentation' of the qualification and our practice?

Teachers' performances are judged by a powerful educational authority, the Education Review Office, who look for the obvious signs of an effective performance – the professionalism, the orchestration and pace, the harmonising, and the presentation. The ERO officers check the teachers' ability to tick the appropriate boxes, and they record their

judgements using the same format. Once the debate about school league tables has subsided, nobody seems to know or care what happens to the judgements. They are filed away and it's business as usual as teachers get on with their practice in much the same way as they always have.

Playing the schooling game in the wider educational community

In the following discussion, I propose that the 'game of schooling' is not restricted to the classroom but is prevalent in all education sectors. While the Project on Learning data was limited to the primary school context, it is considered that the teachers' practice was both influenced by, and a reflection of, the 'game of schooling' as it is played out in the wider educational community.

The teachers were all able to articulate philosophies based on their understanding of the benefits of the constructivist perspective. In addition, the principles relating to effective teaching practice are well documented in the literature, raising the question: "Why are constructivist principles not applied in teachers' practice?"

In attempting to answer the question, it is important to first restate the complexities inherent in teaching. A teacher's philosophy is not the sole determinant of their practice. Teaching is "a complex human endeavour requiring high-level thinking, decision-making, and the capacity to form, consider, and weigh multiple alternatives" (Marano, 1998, p. 429). McGee (2001) describes each teacher as "a complex mix of characteristics, beliefs and attitudes" (p. 13). What they think about teaching and learning, and how they act out these beliefs and views in their work as a teacher will have been shaped by their own upbringing and their own teacher education.

While not a definitive list, factors such as the demands of the curriculum; competing school activities such as drama productions and school sports; constraints of time; class structures and student numbers; relationships with colleagues; parental expectations, and availability of resources have all been shown to influence the many decisions teachers have to make about their practice, and the extent to which they can implement their personal philosophy. Teachers' concerns are real – the demands of the highly prescribed national curriculum, compliance with detailed specifications of achievement objectives and assessment strategies, and the difficulty teachers report to have with documenting some aspects of learning. In turn, these factors influence teachers' expectations of their students, the opportunities they provide for student choice of what and how to learn, and the amount of responsibility they are prepared to devolve to students for their own learning. For these reasons I suggest that we need to look to practices in the wider educational community and to consider the extent to

which all of those who are involved in education are caught up in 'playing the game' of constructivism.

The following discussion of how the 'game of schooling' is played out in the wider community is not intended as an overt criticism of our current education system. It is based on my own nine years experience in teacher training, from anecdotal evidence from my colleagues and the hundreds of teachers I have been privileged to work with in professional development programmes, and from my experience as a student in the university system over the past 12 years.

It is acknowledged that students do learn some things in schools and tertiary institutions from some very dedicated educators. What is argued is that much of our contemporary teaching practice is based on outmoded understandings of what constitutes effective teaching and learning. According to Nuthall (2001) teachers' practice is regulated by the cultural rituals that perpetuate and sustain an adherence to ideas about teaching and learning that are often incompatible with contemporary, research-based understandings of the ways that students learn. It is further argued that much of what is given to students for them to learn lacks relevance to the learner. As a result, much of what is learned by successful learners is not necessarily the result of our teaching, but of the opportunities within the system that they can utilise, and as a result of the opportunities for learning that they create for themselves (Nuthall, 2004). I acknowledge that the students I observed were learning all the time. Much of what was learned, however, was different from what the teacher had intended. For students like Beth and Rewa learning was often limited to how to best manage their place in the social and academic hierarchy of the classroom, and to 'play the schooling game' in accordance with rules that were mostly imposed and regulated by others.

The primary influence on the classroom practice of early childhood, primary and secondary teachers is the pre-service teacher training programmes offered by teacher training institutions and universities. This raises the issue of the extent to which teacher training institutions have contributed to current classroom practice. Most teacher training institutions in New Zealand have only been awarding degrees in the last decade. As a result, prior to the mid 1990's few pre-service training programmes were research informed. Research was seen as a peripheral activity and was only undertaken by a limited number of teacher educators. Up until very recently, there was a high ratio of limited tenure staff due to the practice of secondment of teachers from schools in recognition of their exemplary practice. The majority of these teachers did not have degrees and were unlikely to have had any research experience of their own. There was certainly no research culture within their schools. These 'exemplary' teachers brought with them the model of teaching for which they had been recognised – that of the

busy, active classroom, and so the model was perpetuated at pre-service level. As previously stated, it is the model that is still adhered to by most of those involved in education, including parents, school staff, ERO, and according to Nuthall (2001) even to researchers who can get caught up in the culture of the research community. "In our desire to focus on general variables of theoretical significance that are relevant across many different contexts, we have been blind to the significance of the particular" (p. 11).

Staff at teacher training institutions talk about the same constraints as the teachers in our studies did. They are expected to lecture to large numbers of students from diverse backgrounds, and with a wide range of prior knowledge and experience. Lecturers have heavy marking loads, and bemoan the limited time available to visit their trainees on teaching practice. In most cases their scheduled visits last approximately one hour, with an individual half hour debrief session at the end of each teaching practice.

This raises the issue of the extent to which our current teacher training system is compatible with constructivist pedagogy. Those involved in teacher training also espouse constructivist pedagogy, but how well is it demonstrated in their practice? How much opportunity are trainees really given to plan and teach according to the diagnosed needs of individual learners in authentic contexts? In relation to lesson planning, teacher trainees are taught about the planning cycle, the steps they need to take, and the sequence in which they should be taken. To what extent are we teaching trainees about task design and the fundamental need to incorporate students' interest and to accommodate the range of achievement levels within the class? Trainees are given assignments to do, based on their understanding of the planning process and then they are sent into schools to apply their theoretical understandings.

A major problem for teacher training institutions is the availability of associate teachers who are willing to have trainees in their classrooms on teaching practice. Understandably, the associate teachers want to retain 'control' of their class and in many cases the trainees are locked into replicating their associate teacher's practice. In order to increase the trainee's confidence in the initial stages of their training, sensitive associate teachers will hand pick groups of children for them to work with. Students comply with their course requirements by bringing examples of the children's best work back in neatly presented folders to be marked in turn by the lecturers. Because of the time constraints and number of folders lecturers have to process, their marking of some of the content in teaching practice folders may be superficial. There is always a comment on the presentation. As the allocated time for debriefing with the students is also limited, lecturers express concern that there is never sufficient time to discuss key aspects of the teaching-learning process with the trainees in the required depth. As a result, trainees are unlikely to be challenged to demonstrate their own

understanding of how their practice had influenced what an individual learner had learned or how they had learned it.

Just as trainees are evaluated on their performance, so too are teachers and schools. Colleagues talk with some trepidation about being "EROed." After the visit, many teachers report that it wasn't too bad – other than to show compliance with ERO's assessment and reporting procedures, they were not really asked to justify their practice, or to demonstrate what the children had actually learned. Neither were they asked how they had reached the scores they had assigned to individual learners as a way of documenting what they had actually learned. I recall preparing for the last ERO visit I was involved in where I sat up until 2am on the morning of the visit drawing elaborate "exit" diagrams to display prominently on the walls of my single level classroom that had three obvious means of egress. I don't recall them looking at the diagrams, but I do recall not being asked any questions that made me justify my practice. There was certainly nothing in the ERO report that made me consider changing my classroom practice.

This raises questions in relation to how well the ERO model fits with constructivist pedagogy. What do ERO base their notion of effective practice on? How much do they really know about constructivist pedagogy and how are constructivist principles of teaching and learning demonstrated in their own practice? ERO have their own 'borders' and reporting procedures to contend with. They are also required to work within tight time frames and limited resources. ERO staff also bemoan the fact that although their model has moved from one of straight assessment to one of "assess and assist", the time and resources available to them to assist with the implementation of their recommendations is inadequate. A considerable amount of their time is spent writing reports using language specific to the task. Do these limitations influence the way in which they report their findings to schools? Is this yet another part of our education system that is focussed on the more superficial, procedural aspects of running schools and tertiary institutions which enables them to avoid "paying more than passing attention to what is going on in a learner's mind"? (Nuthall, 2001). In this case those being reported on are the teachers as opposed to the students.

Teacher training institutions are not the only tertiary institutions with practice that is not always consistent with constructivist principles. The system of mass lectures conducted in universities have been criticised by Nuthall (2004) as "medieval practice". In an interview conducted on national radio, Nuthall acknowledged that because he was so caught up in the way universities run, and the culture of universities, that it took him a long time to understand that a great deal of what was happening was "just spinning wheels" (p. 9). Based on his 40 years experience in the university system, Nuthall described a system where students would

take down lecture notes to memorise for the purposes of passing an exam. Some enterprising students would sell their lecture notes to other students. Nuthall argued that "all this lecturing and stuff that goes on is just a kind of self display of academics and nobody knows" (interview transcript, p. 9). Nuthall cited an example of where he sat in on a series of lectures in an integrated course that he was teaching in to find out what the other lecturers were teaching. Nuthall stated:

> The lecturer before me was taking a post-modern analysis of the media and I was watching what the students were writing and they were writing nonsense. They couldn't understand a word of what he was saying. Big long words and so on, so they would try to make up what they thought the words were and I thought, this is sad. These guys are going to go off and try to learn this stuff off by heart and then the lecturer reads the exam papers and they are going to be full of all this curious sort of nonsense. They are going to say "they are dumb students, you know.

At the conclusion of the interview Nuthall recalled another instance involving a conversation between a student in her final year of high school and her sister who was at university. The high school student said: "Look I really don't understand this stuff, can you explain it?" The older sister responded: "Forget about that, just learn it – you'll get all the marks you need." Nuthall concluded the interview by stating: "So I mean the system is really about learning stuff off by heart". The interviewer responded: "It's about bluff?" Nuthall replied: "It's about bluff, often, yes."

In my own experience of the university system at undergraduate level, I was somewhat bemused to be placed in a second year education tutor group run by a tutor who was currently studying for a Master of Education degree. The tutor had gone straight from school to university. In spite of the fact that she was not a trained teacher and had no classroom experience, she was in a position of tutoring very experienced teachers about the culture of the classroom from a purely theoretical perspective. I recall the frustration within the tutor group as a result of the tutor being unable to even enter into discussions about the difference between the rhetoric and the reality of theory and practice, let alone direct or manage the discussion effectively. Out of sensitivity for the tutor's lack of experience, the group focussed on the superficial aspects of education, and we were able to pass the paper based on our regurgitation of the lecture notes and readings assigned to us during tutorials. It was only when I had reached masters level that I felt I had some real choice of studying aspects of education that had relevance to my own practice.

The data also suggests that parents are another group within the wider community who can assert a powerful influence on how the 'schooling game' is played. As suggested by Nuthall (2001), we all consider ourselves to be experts about schooling by virtue of having had at least ten years in the education system. In my own experience, parents can be loosely classified into two groups – those who subscribe to the transmission model of teaching on the

grounds that "It never hurt us to sit up, shut up and learn things by rote." These parents judge a teacher's effectiveness by how quiet and orderly the classroom is. The second group is comprised of parents who support the notion of the busy, active classroom. Like most other members of the wider education community, they equate busy and active with learning. I hear parents continue to ask their children "What did you do at school today?" If the child responds with "Nothing", the parents mostly choose not to believe them. How could they have done nothing when they bring home the evidence of their 'learning' in the form of mostly neat, sometimes error-free, and usually attractively presented 'work'. If it is particularly well decorated, it will probably be used to decorate the fridge!

The need for change

Much of the preceding discussion has focussed on the limitations of our current education systems and has suggested some possible explanations for the limitations. Based on my findings I argue the need for a significant change in the learning ethos in all sectors of education. In the concluding section of this chapter I will discuss some of the challenges to teachers and teacher training institutions in effecting positive change. I identify some recommendations in the literature, and some of the initiatives currently being implemented within my own employing institution that may result in teachers taking a deeper approach to their practice and thus reduce the 'game playing' that has been demonstrated so far.

Teachers can either choose to be powerful agents of change (McGee, 1997) or they can dismiss it on the grounds that it is just too difficult to implement within the constraints they perceive on their practice. Teachers who do wish to make changes to their practice require support. In a discussion of the teaching of science curriculum Newton (1999) promoted the need for teachers to be 'enculturated' into the practice of science teaching, just as students need enculturation into the practice of science. Newton also argued the need for provision of appropriate resources for scaffolding teachers' initial attempts at adapting new techniques. Learning communities are promoted as providing environments that facilitate student achievement (Rogoff, 1990; Sergiovanni, 1994; Alton-Lee, 2003).

As a result of government-funded reports such as the "Best Evidence Synthesis" (Alton-Lee, 2003), there is increasing evidence in the literature of initiatives that have been trialled and found to be effective. Alton-Lee's (2003) findings are consistent with several of those cited in the literature review in Chapter Two of this thesis. Fundamental to effecting any change in their practice is the need for teachers to develop "... a deep knowledge of self as well as student" (Saphier & Gower, 1997, p. 414). There is consensus in the literature about the need for teachers to provide the opportunities and time for students to get deeply involved in relevant, authentic learning that allow for the co-construction of meaning through classroom

tasks (Brandt, 1993; Alton-Lee & Nuthall, 1998; Philips, McNaughton & McDonald, 2001). The notion of 'differentiation' is important for those teachers who are genuine about meeting the needs of individual learners (Moore, 2000).

Effecting change presents a real challenge to those working in pre-service and in-service teacher education programmes (Holt-Reynolds, 2002). It is worth repeating Niemi's (2002) argument that "The effectiveness of teacher education depends on teachers' capacities to learn new methods in their work and primarily to be ready to reassess their working culture" (p. 779). In relation to my own work, I am beginning to notice some gradual changes as a result of teachers' increased awareness of the need for research informed practice, and with the introduction of the new performance based research funding (PBRF) system where staff research activity in tertiary institutions is funded according to research outputs. Staff at the institution in which I work are now well supported with initiatives to encourage active engagement in our own research. This includes provision for doctoral and professional development leave, the availability of funding for individual or group research activities, funding for attendance at national and international conferences, incentives for publishing in refereed journals, the appointment of research co-ordinators, and regular research forums. There has been a noticeable strengthening of a true research culture within the institution. It is hoped that these initiatives are reflected in the classroom practice of our graduates.

In relation to increasing the awareness of experienced teachers, I work with large numbers of teachers who are upgrading their teaching diplomas to bachelors degrees. A requirement of one of the core compulsory courses is for all course members to undertake a small research project based on an aspect of their own practice. By the end of the course the teachers are able to critique research reports, undertake a small-scale literature review, and plan, implement and report a small-scale research investigation. It is a small start, but the teachers consistently comment that it has made them more aware of what is happening for their learners, and in many cases, has caused them to change their practice.

In the next and final chapter, I suggest implications of this work based on the key findings and their impact on my own practice as a teacher educator. Proposals for further analyses of the Project on Learning data and suggested areas for further classroom-based research are then described.

Chapter 9

IMPLICATIONS AND CONCLUSIONS

This concluding chapter is presented in three sections. In the first section I discuss some of the important lessons I have learned from the classroom, and which I consider might be of interest to teachers and colleagues in pre-service teacher training and professional development programmes. In particular, I focus on the following aspects: teacher perceptions of constructivism; teacher planning; the instructional, activity, and report writing / discussion phases of a typical lesson in social studies and science; the significance of classroom discourse, and constraints on teachers' practice. In the second section I discuss my intentions for further analysis of the wealth of data from the Project on Learning that has yet to be transcribed, coded, and analysed. I then suggest areas for further classroom-based research on teaching and learning. In the final section I discuss the limitations of my study in relation to the methodology and the extent to which the findings may be generalised.

First, I must acknowledge the generosity of the teachers who demonstrated their dedication and desire to provide positive learning experiences for their students by willingly participating in our studies. The teachers and their students afforded me a unique opportunity to observe, discuss, and learn about the teaching and learning process in a way that is not usually available to classroom teachers.

Section One: Lessons from the classroom

Challenging teacher perceptions of teaching and learning

This section is particularly relevant to teachers and teacher educators who concur with Lapadat (2000) that "... clearly it is not enough to 'talk' construction but still 'do' transmission" (p. 4).

Piaget's notion of disequilibrium suggests that knowledge grows from tensions in our understandings. Much of what I have learned over the six years of my doctoral study has emerged from the tensions I have discovered between the rhetoric of the constructivist and socio-cultural principles that we as educators espouse, and the reality of our practice which is often inconsistent with our stated philosophies. A significant amount of what I observed in the teachers' practice was a reflection of my own 25 years in the classroom. In common with the teachers in my study, I was able to articulate constructivist principles, but I now realise that my students were provided with limited opportunities to construct and test their own knowledge, or to become autonomous, self-directed learners who were prepared to share responsibility for their learning. The insights I have gained into the reality of the classroom

experience for individual learners have been a life changing experience for me both professionally and personally. The first section of this chapter is written out of a sense of social, and professional responsibility to share my new understandings with interested colleagues.

While it is acknowledged that the culture of the classroom is co-constructed by teachers and learners, my findings demonstrate that the teacher is the key variable in how students experience the classroom (Tomic, 1994). My data demonstrates a direct relationship between the opportunities that teachers provide for students to learn, and subsequent learning outcomes for students. In Chapters 5, 6, 7, and 8, the extent to which the teacher implemented her constructivist philosophy in her practice, and the outcome for selected students has been demonstrated. My findings raise the question of what is required to foster teachers' implementation of their stated constructivist philosophies in their practice?

Nuthall (2001) proposed that teachers are unable to reflect on their practice when they do not really know what is going on in their own classrooms, implying that teachers need to be challenged and supported to find ways to evaluate their own practice. Teachers would benefit from the support of school leaders through the provision of opportunities to undertake professional development, to engage in dialogue with colleagues, and to develop true communities of learners. The provision of release time for teachers to observe what is happening for individual learners in the context of the classroom is considered especially valuable. According to Windschitl (1999), constructivism needs to be regarded as a culture, rather than a fragmented collection of practices. In order to develop a whole school culture of constructivist pedagogy, opportunities for whole school professional development involving all staff could be beneficial in enhancing their understanding of constructivist practice, and in fostering a shared philosophy and practice.

Teacher planning

Based on my findings, I now consider there are two fundamental questions for teachers to consider in relation to their practice. First, "Why do I want my learners to know what I want them to know?" Second, "What are the best methods to teach them this information?" In this section I consider ways of planning units, individual lessons, and classroom tasks in accordance with constructivist principles of teaching and learning.

As the curriculum is sufficiently broad to allow some choice, teachers might consider discussing the range of options within a particular curriculum strand with their students. Teachers spend considerable time and energy planning topics and collecting teaching resources. For this reason it is suggested that where appropriate teachers consider consulting with their students prior to selecting a topic. Such practice may help to ensure that the

students have a sense of ownership over what and how they learn, that the topic has relevance to them, and that their interests have been taken into account.

It is acknowledged that such a suggestion might pose a threat to some teachers in terms of their belief in their fundamental right to select what they teach. However, once the teacher has established that the students' prior knowledge is sufficient to proceed with their selected topic, teachers who approach their planning in creative ways will find ways to maintain their right to choose the topic, while still incorporating student choice within the topic.

As classroom tasks are the primary vehicle for teaching the curriculum, effective planning and task design is fundamental to successful learning outcomes for students (Mergendoller, Marchman, Mitman & Packer, 1998). My findings demonstrated that task appeal was strongly related to students' perceptions of the potential of the task to be fun, interesting, quick and easy to complete, while still being moderately challenging. When a task was perceived to meet those criteria, students were willing to engage with it. In addition, when students were given the opportunity to select tasks within a topic, students consistently demonstrated a preference for tasks that they had some prior knowledge of both in relation to the type of task and the requirements of it. Irrespective of ability, there was a common preference for tasks that were perceived to be able to be undertaken immediately or with minimal requirements to access additional information on how to carry out the task.

All students need to experience success in order to develop the confidence required to take risks and to take the next step in their learning. Teachers in the Project on Learning reported finding the research process a valuable way for students to pursue their own interests. Tasks that incorporated collaborative work were found to be particularly useful for encouraging students with shared interests to work together. My findings demonstrated the benefits of allowing students to work their peers, particularly in relation to increased motivation to engage with the task or where there was an obvious lack of prior knowledge of the topic or task. Through sharing of ideas and perspectives, tasks may retain their challenge by requiring students to use higher order thinking skills and to cognitively engage with the content, yet be achievable within a context that maximises the shared expertise and support of the group.

Instructional phases of lessons

My findings demonstrate that irrespective of the type of task, the extent to which an individual student will engage with and manage classroom tasks is significantly influenced by the effectiveness of the instructional phases of lessons. As discussed in Chapter 5, instructional phases of lessons are used for multiple purposes. From the analysis of the instructional phases of the lessons, a number of problems were identified in relation to the

following: clarity of instructions; the length of the phase; the assumptions made by the teacher about students' prior knowledge and understanding of the task requirements; the use of inappropriate commercially produced resources; the language used by the teacher; the disproportionate number of questions asked by both the teacher and students related to procedures for carrying out the tasks compared with questions related to content; the limited opportunities for students to be active participants due to the domination of the instructional phases by the teacher, and the continuing misconceptions and lack of understanding on the part of the students at the end of the instructional phases in relation to the task requirements.

Suggestions for how the instructional phases of comparable lessons might be approached from a constructivist perspective include the following: To ensure students will be able to succeed in the task, it is important to first establish the status of the students' understanding of the task requirements prior to expecting them to engage with it. To avoid basing the instructional phase of a lesson on assumptions of the students' prior knowledge and understanding of the content and requirements of the task, prior to the lesson students could be asked to demonstrate their understanding of the task. Subsequent planning of the lesson could then be based on the teacher's sound understanding of the status of the students' knowledge.

The importance of determining which students required additional explanations and instructions before they attempted the task was demonstrated in my study. Prior to dismissing the students to work on their question writing task, the teacher offered to help individual students who required additional support or clarification of the task during the activity phase of the lesson. In the case of group tasks, a short concluding group activity where the students list any further questions they might have about the task could be helpful which could then be addressed with the group once the rest of the class have been dismissed to start the task. Such an approach would be helpful in reducing the length of instructional phase of the lesson and as a way of providing the specific information required by a small group rather than general information to the whole class.

The length of instructional phases of lessons is an important consideration. When students are focussed and actively engaged in practising essential task components during the instructional phase, the length of the phase becomes less critical. Observations showed that shorter whole class instructional phases and the provision of additional teacher support for individual students during the activity phase of the lesson were more effective than a lengthy whole class instructional phase. Students at Year 5 and 6 levels were able to sustain their interest for approximately 10-15 minutes if the instructional phase was of interest to them. Based on my findings, I propose keeping the instructional phase of a lesson to a realistic length by ensuring

that the discussion and instructions remain focussed on the content and the task. To reduce confusion and to maximise clarity, instructional phases need to proceed in a logical, systematic fashion.

Instructional discourse

My findings have demonstrated the importance of teacher and student interactions during instructional, activity, and discussion phases of lessons. To ensure a deep, rather than superficial approach to tasks, and as a way of monitoring student understanding, sufficient time and opportunities need to be provided for students to ask questions and discuss content-related matters throughout the lesson. Suggestions for reducing teacher domination of classroom discourse and increasing opportunities for students to participate in discussions during the instructional phase include the inclusion of collaborative group tasks based on discussion and debate. All students need to have opportunities to display their knowledge or express their opinions with confidence that they will be listened to respectfully. My findings have demonstrated the benefit to students when they are encouraged and supported to participate in small group and whole class discussions, regardless of their level of achievement. By assigning specific roles within the groups, students are expected to share the responsibility and have equal opportunities to lead their group's discussion and to report their findings.

In whole class discussions and instructional phases of lessons, the questions that were most effective in furthering concept understanding were those that focussed primarily on content, rather than on superficial, procedural aspects of the task. My findings demonstrate the need for teachers to be aware of the types of questions they ask students, and how they respond to students' questions and answers. When planning the instructional phase of a lesson, designing specific content related questions that require students to demonstrate their understanding of the concepts they have selected to teach may be beneficial. Asking students for their ideas of how they can best undertake the task can help to personalise the task in addition to encouraging students to engage with it and use their creativity.

Activity phases of lessons

Teacher monitoring

My findings demonstrate the critical importance of teacher monitoring during the activity phases of lessons in order to ensure student understanding of the content of the task, and their compliance with requirements for carrying out the task in accordance with the teacher's stated expectations and goals. There were examples of effective teacher monitoring during the Aztec lesson. This was particularly noticeable in the sensitive way the teacher assisted individual students with their question writing. The teacher challenged some of the more confident

students in order to help them clarify their understanding. In addition, the teacher made sure that students who were new to the class received additional help.

Effective instructional phases of lessons provide students with clearly stated goals and expectations of tasks. My data suggests that there is a critical point at which students will either persist with, or abandon a task. To limit the extent to which students can deviate from the teacher's task goals, teacher monitoring of student understanding and compliance with instructions for tasks needs to be focussed and on-going for all students, but is particularly important for low achieving or students who lack confidence. The unobtrusive provision of additional scaffolds such as cue cards and written prompts may be beneficial for some students.

My findings show that once a teacher is sure the student understands the instructions for initially undertaking the task, on-going monitoring is essential in relation to students being able to proceed with subsequent steps in the task. Teacher monitoring of student understanding of content and concepts, rather than on the superficial aspects of tasks is indicated. Where students are working on group tasks, ways of monitoring the content of their interactions to ensure they are task related is fundamental to student compliance and successful completion of the task.

Teacher and student preoccupation with presentation over content

My findings have provided evidence of the teacher and students' preoccupation with procedures for presenting tasks rather than on concept understanding. This was obvious in the Aztec lesson where the majority of the questions asked by the students related to how to set out the questions, how many questions should be written on each page, and whether they needed to decorate their work with borders. In general, the majority of Year 5 and 6 students in my study had not yet developed the independent work skills required to manage their own learning. The challenge is for teachers to ensure they provide sufficient scaffolding by way of task instructions and suggested ways of setting the task out to encourage students to persist with the task and to take the 'next step' when they have depleted their own ideas. Clear, unambiguous instructions complemented with adequate resources and teacher monitoring of student understanding as they progress through the task are required. As with the instructional phase, time to discuss the selected concepts is fundamental to teachers' monitoring of student understanding during the activity phase of a lesson.

Report writing and whole class discussion phases of lessons

My findings demonstrate the need for teachers to allow adequate time for discussion at the end of lessons in order to monitor student understanding, and as a basis for subsequent lesson

planning or revision. The importance of clarifying students' confusion and misconceptions before they move on to new concepts is indicated. Where teachers stipulate that work is to be handed in for marking, the need to ensure that all students comply with the request is considered to be important. Sharing findings in small groups, sharing findings with a partner, and self-evaluation against stated criteria are useful ways of building accountability in tasks and of ensuring all students have an opportunity to discuss and share their efforts.

Implications of the findings for the use of classroom resources

There are a number of implications of my findings related to the use of classroom resources. The ability of students to carry out a task is often dependent on their accessibility to suitable resources. While some teachers spend considerable time locating, making, and organising resources, there is an increasing tendency for schools to purchase commercially produced resources. While they are attractive and convenient, many contain work sheets and other easily reproduced activities that are often poorly designed with little relevance to the diagnosed needs of individual learners. My findings indicate that when teachers do elect to use commercially produced resources, the resources should be carefully scrutinised for suitability prior to purchase.

Other resource problems relate to insufficient or poorly organised resources. To ensure student safety and minimise risk, resources need to be well organised, adequate, and appropriate for the task. Careful consideration must be given to ensure tasks are suitable for use within the confines of the regular classroom. Risks can be minimised by ensuring students have the prerequisite skills for using resources safely and appropriately. One suggestion for doing this is for teachers to model their correct use.

An additional implication of resource use relates to equity of access and active participation of all students. In my study there were examples of low status or less assertive students being excluded from accessing resources. Relegation to the role of passive observer reduced their opportunity for cognitive engagement and the "hands-on" experience that teachers and students reported to be beneficial to learning. Equitable allocation of resources, followed by teacher monitoring to ensure students use them fairly, is indicated. Ensuring the ready availability of adequate resources with specific references or models for less confident or low achieving students may increase their confidence and make the task more manageable.

Location of resources is another consideration in order to limit the potential for distraction, to ensure equity of access, and efficiency of distribution and clearing away. Where teachers positioned themselves in order to observe all students was found to be important not just in terms of monitoring, but for accessibility of students to the teacher, and for optimum opportunities for all students to be noticed and selected to participate in the lesson.

Constraints on teachers' practice

In this section I offer suggestions for how teachers might minimise some of the constraints they reported to have on their practice. Teachers in my study consistently reported that class size was one of the key limitations on their practice. Their concerns are well founded, as it is not uncommon for classes to have in excess of 30 students. As stated by Nuthall (2001) there is no empirical evidence that one teacher can possibly be responsible for the learning of 25 - 30 students simultaneously. The obvious implication of classes with excessive numbers of students is that irrespective of a teacher's efforts, they simply cannot be expected to meet the needs of all of their students. As a way of minimising the constraints of large classes, it is suggested that teachers implement strategies that maximise the use of peers as resources. Teachers and students consistently report the academic and social benefits of students learning from their peers. Consistent with constructivist principles and the notion of communities of learners, the implementation of buddy and peer tutoring systems can be an effective way of reducing the pressure on the teacher by utilising the expertise of all participants in the classroom.

The teachers were also unanimous in their concerns about the 'crowded curriculum', and the pressures they felt as a result of the introduction of several new curriculum documents in recent years. As argued by McGee (1997) while the central authorities may control the content of the curriculum, they are still dependent on teachers to implement it. In this sense "teachers hold the ultimate power" (p. 66). In most New Zealand primary schools, individual teachers have a large degree of autonomy over what they teach. Based on my own experience, I consider that teachers need to resist any unrealistic demands to cover too much, and to be selective about what they teach. Providing that what they select is based on sound pedagogy and is compatible with the needs and interests of their students', teachers will be well placed to justify their practice as required.

Teachers are given the opportunity to have some input into national curriculum documents through trialling the drafts and providing feedback to the developers. I consider that teachers should place a premium on such opportunities. If the time available for trialling curriculum documents is inadequate, there is a risk that teachers will be expected to implement curriculum that is unsuitable in relation to content, or unrealistic in the amount they are expected to cover. When required, teachers should be proactive in requesting realistic time frames and additional support to undertake such trials.

Sharing expertise

Teachers in my study consistently reported a lack of confidence in their own knowledge of some curriculum areas, particularly in science. Unlike secondary schools where teachers are

subject specialists, most primary schools are organised with individual teachers having full teaching responsibility for their own class across all areas of the curriculum. Primary teachers receive basic training in all curriculum areas, and while some teachers may have a particular curriculum strength or interest they cannot be expected to be specialists in all curriculum areas. There are very few specialist curriculum teacher positions in primary schools and most primary schools do not have specialised facilities for teaching different curriculum subjects. Subjects like science and art are mostly taught within the confines of the regular classroom and without specialised equipment. As a result some curriculum areas are neglected, implying that curriculum developers need to consult widely with teachers and students in order to produce documents that are both manageable and relevant. Consideration also needs to be given to the way primary schools are structured to best utilise the strengths of the staff.

The issue of primary teachers being trained as general teachers rather than as subject specialists also has implications for current models of teacher training. In the present system, teacher trainees have limited opportunities to develop specialist curriculum strengths. This model reflects the way that primary schools are currently organised. It is unrealistic to expect schools to change the way they are organised due to the lack of specialised facilities. Additionally, any significant changes should be based on sound research evidence of the benefits to teachers and students. This is likely to be a very gradual process and will be dependent on the funding of research into the trial of new approaches using specialist subject teachers in primary schools.

Encouraging learners to take responsibility

The issue of learner responsibility is complex. Teachers expressed concern that their students lacked the skills and motivation required to be independent learners. The students were consistent in their requests for greater opportunities for choice of what and how they learn. Teachers and students were able to articulate the principles that are fundamental to encouraging autonomous, self-directed learners who are willing to accept responsibility for much of their own learning. The data showed that the teachers provided limited opportunities for students to be agentive in the learning process. In addition, when teachers did provide students with choice and opportunities for taking increased responsibility for their learning, many of the students were unprepared to put more than a minimal amount of effort into their work.

During the post-unit interviews, many of the subjects demonstrated the understandings required to take greater responsibility for their own learning than is commonly acknowledged by teachers or students. In common with the teachers, the subjects demonstrated their understanding of many aspects of the teaching-learning process that are fundamental to successful learning outcomes. While they did not often apply them, the subjects could

articulate the rules for working in groups, and the need to share resources. They understood the complexities of social relationships with peers, and the impact of their behaviour on other students' learning. They also understood the relationship between their application and the effort they expended on a task and the quality of work they produced. Based on the subjects' stated understandings, I consider that the responsibility for their learning should not rest solely with the teacher.

In order for students to become autonomous self-directed learners, my findings demonstrate the need for teachers to set high but realistic expectations for all students within classroom programmes that scaffold students' as they take increased responsibility for their own learning. My findings show that students at year 5 and 6 need time to develop the pre-requisite skills to manage their own learning effectively and in a responsible manner. It is suggested that increased opportunities for students to become autonomous learners are provided as part of a gradual process. One suggestion is for teachers to begin devolving responsibility to their students by giving them a specified period of time each day where they can be involved in self-directed activity. The periods of time may then be increased as the students demonstrate their competence and ability to take increased responsibility for their own learning.

Implications of the findings for the wider educational community

While my findings have exposed some of the strengths and limitations of current classroom practice, the implications of the findings extend beyond individual teachers' practice in the context of the classroom. In the previous chapter, the perpetuation of the busy, active classroom model in teacher training institutions was discussed. While this is gradually changing with the increasing use of research informed practice, there is also a major and rapid move to mergers between autonomous teacher training institutions and universities. While such mergers are expected to result in benefits to both and staff and students, in any teacher training programme there is a need for a balance between the theory of teaching and learning, and classroom practice. Students may espouse theories of teaching and learning, but they must also be given the strategies of effective classroom management in order to implement their theoretical knowledge. Changes in teacher training programmes also have implications for experienced teachers and for those staff working in in-service teacher education programmes. In my own work in teacher professional development, the courses that are considered to be most effective are those that provide opportunities for teachers to gain deeper insights into their own practice. With the increasing focus on research informed practice, professional development courses need to incorporate opportunities for teachers to develop research skills and the encouragement to become practitioner researchers.

My findings also have implications for the way that teaching is assessed. It is acknowledged that some form of monitoring is required to ensure students are receiving a high quality education. Most Education Review Officers are experienced ex-teachers, often with senior management experience. They have a sound understanding of the way schools are organised and of the constraints on teachers' practice. If they understand that teachers cannot be expected to meet the needs of individual students, how much of their focus is primarily on the systems and procedures for managing schools rather than on the learning outcomes for students? Unless the model that is used to assess school effectiveness is compatible with current theories of teaching and learning, the value of such reviews will be seriously limited. As previously discussed, while teachers express their anxiety about ERO visits, how much notice is taken of the resulting ERO reports and are there more effective ways of assisting teachers to implement best practice? This indicates the need for an evaluation of the current system of school and teacher assessment.

The issue of cohesive, school-wide approaches to teaching and learning raises the question of what is valued by a particular school community and how is it demonstrated? How do school communities reach consensus on what is really important and valued by their institution? My data has demonstrated the demands on teachers to be involved in extra-curricula activities. Examples have been provided also of the pressure of unrealistic parental expectations on the teacher's practice, with parents who would not allow their child to be present at teacher-parent-child conferences on the grounds that "it has nothing to do with my child." In another example, the parent stated: "If my kid's got a problem then you fix it, you're the teacher." There is a need for consultation within the school community to ensure all members are aware of their reciprocal roles and responsibilities. Parents must accept that teachers cannot be expected to take full responsibility for their child's education. The process needs to be one of mutual collaboration and support between teachers and parents / caregivers to enable the child to meet realistic, achievable goals.

Talking to children

While my observations of teachers' practice and the interviews I conducted with them have been extremely valuable, it is from my observations and interviews with the students that I have learned the most. As a busy classroom teacher I had certainly been aware of individual students in my classes, particularly the more challenging ones. What was largely missing from my understanding was the very unique way an individual student experiences the classroom. I came to realise that while we can learn much from the literature, we can learn more from the children themselves. As stated by Nuthall (1999): "In the end, only direct evidence from students themselves can be the guide to the cognitive processes involved in carrying out classroom tasks" (p. 36).

The subjects in my study have surprised me with their very articulate insights into the teaching and learning process. Through talking with them, I have gained a much deeper appreciation of their experience of the classroom and how they manage their place in it. The amount of time the students were prepared to spend sharing their insights with me, and the honesty of their responses indicated that they knew I was genuinely interested in what they told me. In turn, they were pleased to have been given the opportunity to share their experiences of the classroom with the interviewers as demonstrated in this response from Tyler: "Oh, well thank you for giving me this opportunity to actually tell you what I know, without like, anyone interrupting me and telling me no, this is total nonsense." As stated by Buzzelli and Johnstone (2001): "Put simply they care about what they say in class because they know it matters" (p. 882). I am convinced that my own teaching would have been much better informed and more relevant to the needs and interests of individual learners if I had taken more time to talk to the children in my own classroom.

Returning to the metaphor of the 'game of schooling' and the analogies of actors and the classroom as the context for the 'dramas' and performances, I now wonder what would happen if we changed the roles and handed over increased responsibility to the students for the overall production from writing the scripts, designing the sets, and sourcing the props. The performance might be more amateur, but I suspect it would be considerably more original and authentic. I doubt if the students would learn less. I strongly suspect they would learn more, and that what was learned would certainly be of greater relevance and interest to them.

Application of the findings to my own practice

While I can reflect on my own teaching career with a measure of integrity from knowing I tried my best, I now have a sense of frustration that I could have been so much more effective with the benefit of the insights that I now have. Some of this frustration is compensated for through sharing my findings in my current work in professional development with experienced teachers who are upgrading their qualifications to bachelors and masters degrees. As I use my data in my teaching and recall my observations from the studies, I watch the teachers nodding in agreement as they recognise much of their own practice. Many lively debates follow as we consider the continuing challenges to meet the individual needs of large numbers of students.

It is argued that teachers can never be expected to appreciate the complexity of the classroom and the impact of the social and cultural relationships that exist amongst the members, unless opportunities to conduct their own classroom-based research are provided. Many aspects of my own research methods and experiences are used to support these teachers to conduct their own research as an integral part of their course work. In turn, through examining aspects of

their own practice many of these teachers report the research experience, even on a small scale, to be 'life-changing' in relation to their own professional development and practice. The following quote is particularly relevant:

> Stand aside for a while and leave room for learning. Observe carefully what children do, and then, if you have understood well, perhaps teaching will be different from before (Edwards, Gandini & Forman, 1993, p. 77).

Extending my personal research interests

The Project on Learning is unique in the world in relation to the richness of data that has been collected and transcribed (Nuthall, 2004). Much of this data has yet to be coded and analysed. My intention is to extend this study by working with the data in a number of different ways to answer a range of questions about classroom teaching and learning. For example, I am particularly interested in extending my analysis of classroom tasks. In one particular unit on space, the teacher had designed a range of activities using Bloom's Taxonomy. Based on a range of measures of student achievement, and on the teacher's perceptions of the students' ability levels, students were individually allocated a number of activities. The students were then allowed to select their own activities from the range provided by the teacher. Preliminary analyses show a consistency in student preferences for particular tasks. I intend to conduct further analyses of the data in relation to the characteristics of the preferred tasks, and to examine their effectiveness in relation to student task engagement, concept learning, and the quality of the work produced.

A further extension of this study relates to a model of teaching that I developed during the second year of my involvement in the Project on Learning. The model was not trialled due to the nominated teacher gaining another teaching position at a different class level. The model is designed to increase the opportunities for students to take responsibility for their own learning. Recognising that Year 5 and 6 students cannot be expected to assume such responsibility without the prerequisite skills, the model is designed for implementation in six steps. My intention is to trial the model in the future. The Project on Learning methodology will be modified and used to measure the effectiveness of such an approach in relation to learning outcomes, and from the perspectives of students and teachers.

In addition, I am particularly interested in expanding my research interests based on the perspectives of children and how they learn and remember. Rhys, one of the Year 5 subjects, referred to his brain as a "vacuum cleaner" stating: "I can use my brain to help me remember things. It works like a vacuum cleaner. It sucks up the information and keeps it in there." Rewa doesn't have to do a lot of practising to remember things "Cause once it's in my head it's hard for it to die." I plan to extend my findings by interviewing more children to gain their

ideas about how teachers can help them to "suck relevant information into their brains," and assist them to generalise their new learning both within the classroom and in their wider community contexts.

With the establishment of the Graham Nuthall Classroom Research Trust and the provision of an annual research award, one of my on-going responsibilities is to help support the recipients of the award. This will ensure the continuation of classroom-based research using the methods developed by the Project on Learning research team.

Areas for further research by the wider educational research community

There are a number of suggested areas for further classroom-based research to emerge from this study. While not a definitive list, some of the following areas may be of interest to other researchers. My findings have raised the question of whether the limited implementation of constructivist practice is due to constraints on teachers' practice, or whether it is because they really do not understand constructivist pedagogy. It would be of interest to sample larger numbers of teachers to determine the reasons behind their practice, and the extent to which they understand constructivist pedagogy.

Further research in relation to task design and the incorporation of student choice is indicated. For example, an examination of the effects of opportunities for students to participate in all aspects of unit planning and task design in curriculum areas like science and social studies, could be of benefit to teachers in relation to student interest, motivation, and task engagement.

An important finding from the Project on Learning is that differences in children's ability are likely to be the result of accumulated differences in their classroom experiences. My study has demonstrated the unique ways that individual students co-construct the culture of the classroom and manage the social relationships within it. Peer social relationships were found to have a significant effect on opportunities for students to learn, or not learn. This was particularly evident when students were assigned group tasks. Confident, assertive students were more likely to dominate the resources resulting in increased opportunities for them to cognitively engage with the concepts and to have 'hands-on' experience with the tasks. Further research into the design and management of group tasks, and the effects of student behaviour on opportunities for individual students to participate, or alternatively, to be excluded from participating in group tasks, is indicated.

There is a need for further research that examines the structure of lessons. My findings have demonstrated the significance of the instructional phases of lessons on student understanding of task requirements, their conceptual understanding, and the procedures for carrying out the tasks. An examination of the way that instructional phases could be structured to promote the

active participation of all students is indicated. In addition, research into the optimum length of instructional phases of lessons to ensure student focus and engagement would be of interest. The activity phase of lessons is another critical area in relation to student learning and task engagement. Further research that examines the significance of teacher monitoring and student compliance with task instructions would be beneficial to teachers in relation to the importance of monitoring student engagement for conceptual understanding rather than for superficial aspects such as task presentation.

Finally, my findings have demonstrated the importance of talking to children to gain their perspectives of the teaching-learning process. Practitioner research that incorporates the perspectives of students' would help teachers to better understand the unique ways that individual students experience the classroom.

Limitations of the study

Due to the extensiveness of the methodology employed in the Project on Learning, most of the methodological limitations of the study relate to issues of replication. It is acknowledged that the methods for collecting, transcribing, coding, and analysing the data were both expensive and time consuming. What makes the methodology unique in the world is the substantial amount of in-depth data that can be collected. In order to replicate the methodology, researchers would need to commit adequate time and resources to any future research. Failure to do so would compromise the integrity of the methodology, and limit the amount and value of data they could collect.

In relation to my own study, I do not consider that my findings can be generalised to all Year 5 and 6 classrooms. Despite the detailed data collection and the in-depth coding and analyses of teacher and student experience conducted over a period of six years, my findings can only be considered as providing a "snapshot" of the reality of the classroom experience for selected individual subjects and their teacher at a particular point in time. While the implications and general principles related to my findings are considered to be worthy of consideration by teachers who are particularly interested in constructivist pedagogy, the extent to which the findings can be generalised to their own unique educational contexts and practice are limited.

In conclusion, the comments made by the teachers in my study were consistent with those made by teachers in Van Manen's (2002) study.

> At the end of the day, what matters to teachers is that they provide their students with positive experiences, that there was a good atmosphere in their classes, that students felt safe and successful in their learning activities, that personal difficulties could be worked out, that life was happy and good for them and their students (p.138).

The most obvious omission is any reference to the need for teachers to do what Nuthall (2004) advocated, that is, "to go that bit further which is to find out whether they're understanding what is going on, and whether they are learning from it or not" (p. 3). Almost a century ago Dewey (1910) wrote: "Learning in the proper sense is not of learning things, but the meaning of things" (p. 176). As educators, we know that understanding is fundamental to effective teaching and learning. The challenge is to demonstrate our understanding in our practice.

A final cautionary comment from Holly

If teachers neglect to provide genuine opportunities for students to be active participants in classroom teaching and learning processes, the consequences are clear. As I have learned so much from the subjects in our studies, it seems appropriate that one of the subjects should have the last word. Holly, a Year 6 subject in study 17, was unhappy to be studying space. When asked how she was enjoying the topic Holly stated: "I'm not really interested in the space topic we're doing at the moment. Done space about five times before. Just the same stuff over and over again". What Holly was really interested in learning about was the sea, and she had obviously thought about how she would introduce the topic to the class.

> "I would draw on the board a sea, like the top of the water in a square but nothing in the middle. Then I would get the kids to come up and I'd say, that person can draw a fish, the next person can draw a shark, and then everyone can pick something out of that sea to do their research on. They can get a choice of what they want to learn about, cause some girls might not want to learn about sharks and stuff like that. They might want to learn about something else. So if you just made them learn about sharks, they might not want to, and they might just not listen and stuff like that".

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Appendix 1

Content codes used to classify the relevance of information

The content codes included the following:

Explicit item answer

Exact item answer

Approximate item answer, e.g. paraphrase

Wrong or misleading answer

Implicit or partial item answer

2.1 Answer is logically implied

2.2 Significant parts of a complete answer

2.3 Corrections and information about what the answer is not

Additional information or explanation

Definitions and descriptions of key elements

Background and related information

Reasons and explanations

Analogies and synonyms for key elements

Examples, instances, or subsets

Negative examples and instances

Student experience related to the answer

Preparatory and contextual information

Describing the focus or purpose of activity

Review of previous information, discussion

Narrative context of key concepts, events

Preparatory activity or discussion

Question asked without relevant answer

Mention only of keywords or synonyms

Keyword is spoken

Keyword is read or written

Keyword is represented in picture or diagram

Activities and procedures

Carrying out procedure that produces answer

Making a model or representation of key concept

Instructions for relevant activities

Visual resources available but not the focus of activity or discussion

Resources that contain all relevant information are visible

Resources that contain part of the information are visible

2. Behaviour and resource codes

The following codes were used to classify the context in which the students were operating, the behaviours exhibited, and the resources being used.

Context

C	whole class
G	group
I	individual

Behaviours

LT	listening teacher	LP	listening pupil
TT	talking teacher	T pg	turning page
G obs	glancing at observer	M	moving
St	standing	H	hand raised
D	desk open, finding equipment	G	looking around
L	laughing, smiling	Pf	dislike, pulling faces
?	thinking, puzzled	Y	yawning, bored, sleepy
Org	organising books, equipment	F	fiddling
TP	talking peer	TS	talking self
NVC	non verbal communication	W	watching
WT	watching (looking, glancing teacher)	R	reading
WP	watching (looking, glancing peer)	ROW	reading own work
Dr	drawing	Wr	writing

Resources

Mic	microphone
Pic	picture
Q	question
T	teacher
Bk	book
Wk	work, worksheet, instruction sheet
Bb	blackboard
Wb	whiteboard
OHP	overhead projector

Appendix 3

Categories of behaviour in group activities

A. Getting and clarifying instructions

1. Teacher gives general instructions at beginning of activity to whole class
2. Teacher gives instructions during activity
   - 2.1 Instructions to the whole class
     - 2.1.1 Teacher gives instructions about moving along
     - 2.1.2 Teacher models what groups should be doing by making an example of one group
     - 2.1.3 Teacher gives instructions about specific activity or corrects activity
   - 2.2 Instruction to a specific group
     - 2.2.1 Questions what a group is doing
     - 2.2.2 Corrects what group is doing
     - 2.2.3 Praises a group for what they are doing
     - 2.2.4 Gives specific instructions to a group
     - 2.2.5 Re-organises seating or individual roles
     - 2.2.6 Re-organises the way the group is working

2. Pupils read prepared instruction sheet
   - 3.1 Reading instruction sheet at the beginning of the activity
   - 3.2 Reading the instruction sheet during the activity
   - 3.3 Asking peer about what the instructions are

B. Interpreting instructions and organising resources

1. Socially interactive interpretation and organising
   - 1.1 Mutually co-operative interpretation and organisation
   - 1.2 Debate and negotiation of interpretation and organisation
   - 1.3 Negotiating the exchange of resources
   - 1.4 Organising other children to organise resources
   - 1.5 Organising who should work with who
   - 1.6 Asking other students for help in organising resources

2. Interacting with teacher about finding or organising resources
   - 2.1 Asking the teacher for help to find resources
   - 2.2 Getting help from teacher to find or organise resources

3. Individually getting, arranging resources

C. Carrying out the procedures required by instructions

1. Individual organizes and carries out the required procedure
   - 1.1 An individual organises and carries out the procedure (others may be watching, but not contributing)
   - 1.2 Watching passively while others carry out the procedure
   - 1.3 One person tries to correct the activity

2. Group carry out procedure together
   - 2.1 One person organises another to carry out the procedure
   - 2.2 Group carry out the procedure co-operatively but without comment
   - 2.3 Group carry out procedure, commenting on what they are doing (e.g. asking each other what they are doing)
   - 2.4 Reporting to each other what they have done (procedures)

3. Peer group talking about observations and results
   - 3.1 Group talking with each other
   - 3.2 Student tells others the results of the procedure

4. Group talking with each other about reasons, explanations

5. Talking with teacher about observations and results
   - 5.1 Reporting to the teacher what they observed during the activity
   - 5.2 Talking interactively with the teacher about observations and results during the procedure

6. Talking with the teacher about reasons, explanations
   - 6.1 Teacher asks them for their explanations
   - 6.2 Teacher provides cues or a model for explanation

7. Teacher carries out the procedure with the group, instructing them in detail, or modelling the procedure.
   - 7.1 Teacher goes through a sequence of activities
   - 7.2 Teacher corrects a specific procedure

8. Group carries out an incorrect or misinterpreted procedure or and accident occurs with the materials.

9. Engaging in alternative and playful activities and uses of resources
   - 9.1 Individual playful and alternative activities
   - 9.2 Socially interactive playful and alternative activities

D. Social interactions unrelated to task procedures

1. Positive social interactions about unrelated topic within group
2. Positive social interactions about unrelated topic with non-group member
3. Social interactions involving personal conflict unrelated to activity

E. Writing the report

1. Organising pupil's own topic book, line sheet, pens, pencils, ruler
   - 1.1 Organising materials individually
   - 1.2 Organising interactively with others

2. Obtaining copy of instruction sheet

3. Finding out what to write, what questions to answer, how to complete the report individually or interactively with peers
   - 3.1 Reading instruction sheet
   - 3.2 Asking peers about what to do in report
   - 3.3 Talking with peers about what to do in report, what to write, how to complete it, what are the answers.

4. Discussing what to write in report, how to complete it, with the teacher
   - 4.1 Asking teacher about what to write in the report
   - 4.2 Teacher gives specific instructions to student about report
   - 4.3 Teacher reads and comments on a pupil's report.

5. Discussing what they have written in their report
   - 5.1 Talking about what they have written
   - 5.2 Talking about the mistakes with each other or teacher

6. Writing the report
   - 6.1 Copying title and questions from instruction sheets
   - 6.2 Writing what they did

6.3 Writing, or making a drawing of, what they saw, observed

6.4 Writing an explanation or reason for what happened

7. Student reads own writing just completed or from previous day's work

8. Reading another pupil's writing in the report

F. Spending time doing nothing active

1. Gazing round the room, looking at others working or teacher talking to another group
2. Student pauses during activity, apparently unsure, confused
3. Reading over previous days work that is not relevant

Appendix 4

Sample Teacher Interview Questions – All Studies

Planning

- When planning tasks and activities for the unit, what considerations influenced your planning and choice of tasks for inclusion?
- Were there any resources that were particularly useful?
- To what extent was your planning influenced by the curriculum documents?
- How much time did you allocate for the unit? Was this sufficient – why / why not?

Task Effectiveness

- Which tasks do you consider were the most effective in promoting understanding of the content, and in achieving the learning outcomes or achievement objectives you had set?
- What was it about these tasks that made them particularly effective?
- Were there any tasks or activities that you considered ineffective? Why?
- Which tasks were the most manageable from a teaching perspective? How and why?
- Which tasks do you consider were most easily managed by the students? How and why?

Changes and adaptations to task and planning

- Did you find you had to make many changes to your original unit planning as the unit progressed?
- What did this involve and why did you consider the changes to be necessary?
- Did you adapt or change any of the tasks during the unit? If so, what influenced you to make the changes?

Perceptions of students throughout the unit

- Which tasks do you consider were the most effective in engaging the students? Why?
- What is your impression of the way the students responded to the tasks during the unit?
- Is there anything in particular that stood out for you as a teacher with regard to the students' general classroom behaviours during the unit? (for example on-task / off-task, interest, motivation, co-operation)
- What was your overall impression of student effort and achievement at the end of the unit?

Independent work

- In your experience, what are the prerequisite skills necessary for students of this age to work independently on tasks?
- How much structure / scaffolding do you expect to have to provide for students of this age to work effectively and independently individually?
- What strategies do you use to foster necessary independence?

Student decision-making

- In your experience, what is the effect on students of providing them with opportunities to be involved in classroom decision-making processes and for making choices about aspects such as content, presentation, topics, methods of investigation?
- Were there any aspects of any of the initial planning of the unit that you feel students could have input into?
- Were there any tasks that were conducive to giving students opportunities to be actively involved in decision-making?
- To what extent do you consider students of this age should be / or are capable of being involved initial planning and decision-making with regard to the content and tasks to be included in the unit?

Group work

- What do you consider to be the prerequisite skills for students of this age to work effectively in a group situation?
- How much training do you consider is necessary in order to develop skills for working effectively in a group situation?
- What are your general impressions of the way in which this class of students work in a group situation?
- How do you assign students to groups?

Monitoring of students during independent task work

- What strategies do you use for monitoring individuals / groups of students during independent task work?
- What are some of the considerations for you as a teacher related to issues of teacher expectations and student accountability?

Constraints on Practice

- Are you conscious of any particular constraints on your practice as a teacher?
- If so, what are they, and how do you deal with such constraints?

Appendix 5

Additional teacher interview q uestions – Study 18 Aztecs unit

Independent Research Projects

Question Writing

- The students' ability to write open and closed questions to focus their investigation on seemed very important. How well do you consider the students managed to write suitable questions?
- The students were asked to write the questions without consulting their peers. What do you consider to be the benefits of students working in this way?
- Did most students manage to write their questions without peer collaboration?
- How much experience have these students had in writing such questions?
- Are there any additional strategies you would consider using next time, particularly for those students who may have had problems writing suitable questions?

Conducting the research

- Have you incorporated elements of choice into what the students could study in previous units with this class?
- What do you think were the main influences on students to select the aspect they did?
- What do you consider are the benefits of enabling students to work in this way?
- What are the challenges from a teaching perspective when you have students all working on individually selected topics?
- How much scaffolding did you find you needed to provide?
- How do you feel the students coped with managing their research time in class?
- Students were able to work collaboratively on their presentations. How well do you consider they managed to work in this way?
- What are your thoughts concerning the amount of time you had allocated for the unit?
- Was it sufficient / too much?
- What were your impressions of the research presentations?
- Did the students meet your expectations with what they achieved?
- Are there any aspects of the unit that you would consider changing or adapting in the future?

Appendix 6

Student interview questions – Study 16 kitchen chemistry unit

Tasks & activities related to the actual unit

- How did you enjoy the unit overall?
- What were some of the real highlights for you?
- What tasks, activities, or experiments really stood out for you?
- How did the experiments turn out?
- Did you understand what the experiments were about?
- Were there any activities or tasks that you didn't enjoy? Why?
- Were there any tasks that didn't go very well for your group? Why?
- You were asked to write down quite a few predictions. Do you find it easy or hard to make predictions?
- What makes it easier to predict some things than others?
- What were the highlights of Mrs D's last session for you?
- What other science experiences have you had outside of school?
- How helpful are those experiences with what you have to learn at school?

Working in groups

- Do you enjoy working in groups?
- How well do you think your group worked together?
- What went well in your group?
- What didn't go well in your group?
- Do children of your age take turns and share equipment well?
- What happens if you don't get to have a turn – how do you feel?
- If people in the group don't share or you don't get a turn, can you still keep interested in what the others are doing?
- If you can't, what do you do?
- If the group is having problems, what can you do to solve them eg conflicts?
- Have you had much training in how to work well in a group?
- What do children need to be aware of before teachers can expect them to work well in groups?

Memory

- Is it easy for you to remember things?
- If there is something that you really want to learn and remember, how do you do it?
- What do you find really helps you to learn and remember things?
- How many times do yo find you have to read / write / say something before you can remember it?
- How long do you think you can remember something for?
- Can you remember something special that happened to you, or that you learned a long time ago?
- Why do you still remember it?

Choice

- Is it important for children of your age to be given some choices about what they learn at school?
- What sort of opportunities do you have in your class to make choices about what you learn / how you learn / when you do something?
- If I said to you that you had a whole school day to choose what you learned and how you could present your information, what would you choose to learn?
- Where could you get your information from?
- How would you share your information or present it to others?
- Can you remember any particular work you have done that made you feel really proud of what you had achieved – why?
- Would you like to work that way?
- What would the teacher's job be if children were able to choose what they learned?
- Do yo think you would learn as much? Why / why not?

Advice to teachers

- If I waved my magic wand and turned you into a teacher, what kinds of tasks and activities would you plan for children so that they would really learn things?
- How important is it for school to be a fun place to be?
- How can teachers make school more interesting for children?
- When I work with trainee teachers, they often ask me "How can I be a successful teacher? I think that children are the best people to tell them. What do you think makes a teacher really successful?

Appendix 7

Student interview questions – Study 18 Aztecs unit

Independent research projects

- Determining what influenced students' to select their particular aspects of the topic to study. Why did you select the particular aspect to study?
- Tracing back where the student's original interests originated. Was there anything in particular that caused you to be interested in (specify selected aspect)?

Writing independent research questions

- What kinds of things were you really interested in finding out?
- How did you enjoy writing your own research questions?
- Did you find it difficult to think up questions? Why / why not?
- Did you find it easy to understand the difference between open and closed questions? What helped you to understand the difference?
- Did you write down any questions that you already knew the answers to?
- How did you feel about having to write your own questions? Did you discuss them with anyone else?

Carrying out your independent research

- Resources. Who did you talk to when you were researching your topic?
- Where did you find your resources?
- How much assistance did you receive?
- Time available to carry out your research. Did you have enough time during school periods to carry out your research and prepare your presentation?
- How much time do you think you spent on your project at home?
- Work done by peers. Did you take much notice of what other students were doing during the research sessions at school?
- Did you become involved in any other students' research?
- Did you help other people to locate information about their topic?
- Did other students help you with information about your topic?
- What were some of the most interesting things you found out during your research into (name of topic)?
- What were the real highlights of the study for you? Why?
- What were some the less interesting or least enjoyable parts for you?
- Where did you get your ideas about how to present your research?
- Did you get help with your presentation? If so, from whom?

- Are there any things you would choose to do differently next time?
- How did you feel about having to present your research project to the rest of the class?
- Were there any presentations that really stood out for you?
- What was special about these particular presentations?
- What do you think about students sharing their work with others?
- Do you think you learn much from other students in your class?
- What are some of the things about other students' work that you particularly notice or remember?
- How did you feel about the other students' evaluations of your project?

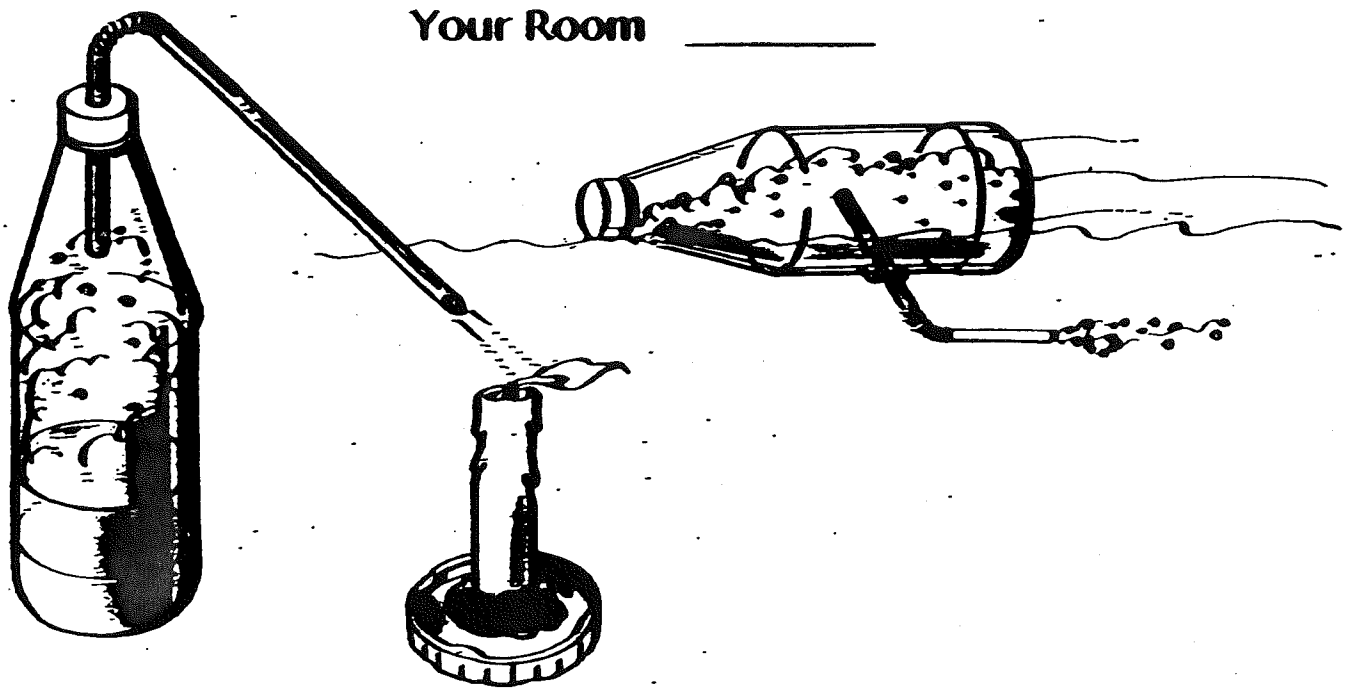
Appendix 8

Post-test Study 16 Kitchen Chemistry unit

Fizzes and chemicals and molecules and atoms

Your name _____

Your Room _____



June 2000

Education Department, University of Canterbury

Fizzes and chemicals and molecules and atoms

1. When we mix sugar in warm water until it all disappears we call that

- ☐ evaporating
- ☑ dissolving
- ☐ reacting
- ☐ I don't know

2. If someone asked you to explain what the word 'liquid' meant, what would you say? _____

_____

_____

_____

3. Which of these are chemicals?

- 301 ☐ water
- 302 ☐ salt
- 303 ☐ baking soda
- 304 ☐ air
- 305 ☐ food colouring
- 306 ☑ chalk
- ☐ none of these are chemicals
- 307 ☑ all of these are chemicals

added
307 carbon dioxide
308 coca cola

no answers here for people who have ticked some of the above set so have just used top 6 items

4. If you stir sugar in water, the sugar will disappear quickest when the water is

- ☐ freezing cold
- ☐ just out of the tap
- ☐ as warm as your hand
- ☑ very hot
- ☐ I don't know

Keep trying!

5. Where does sugar go when you have mixed it in warm water and you can't see it any more? _____

_____

_____

_____

6. When we mix two things together like mixing salt in hot water we end up with

- ☐ a chemical reaction
- ☑ a salt solution
- ☐ a compound
- ☐ I don't know

7. Which of these are acids? (There could be more than one)

701 ☐ chalk
702 ☐ rain water
703 ☑ lemon juice
704 ☑ vinegar
705 ☐ dishwasher liquid
706 ☐ Coca cola

8. If you dissolve some salt in a cup of water, is there any way you could get the salt out of the water again?

☑ YES ☐ NO

9. Why do you think that? _____

_____

_____

_____

10. What do we call something that will make bubbles if it is added to an acid?

- ☐ a gas
- ☑ carbonate
- ☐ a powder
- ☐ carbon dioxide

Thanks for trying so hard

11. When you put some things in an acid, they fizz or make bubbles. Which of these things will fizz or make bubbles if you put them in an acid?

111 ☑ chalk
112 ☐ rain water
113 ☐ soap
114 ☑ baking soda
115 ☐ paper
116 ☐ bread

12. What is in the bubbles in a bottle of coke?

☐ air
☐ nothing
☑ a gas
☐ I don't know

13. When you boil water in a saucepan on the stove and steam comes off we call that

☑ evaporation
☐ condensation
☐ salination
☐ I don't know

14. When you cut a newly baked cake there are little spaces or holes inside it. What is in these little spaces or holes?

☐ nothing
☐ air
☐ steam
☑ carbon dioxide
☐ I don't know

Keep trying → you're really doing well!

15. Suppose you wanted to carry out a scientific experiment. You wanted to find out if you would get more fizz (or bubbles) if you added chalk to lemon juice or you added chalk to vinegar.

To do this you must make a **fair test.**

A fair test is when

- ☐ you make sure all your containers are completely clean
- ☑ you keep everything the same except the lemon juice and vinegar
- ☐ you carry out the test several times till you get the right answer
- ☐ I don't know

16. Can you match the chemical name with the ordinary name? Draw a line between the chemical name and the ordinary name.

161	Sodium chloride	o	o baking soda
162	Carbon dioxide	o	o a gas
163	Sodium bicarbonate	o	o chalk
164	Calcium carbonate	o	o salt

17. If we mixed up some baking soda in lemon juice, it would fizz or make bubbles. After it has stopped fizzing, is there any way we could get the baking soda out of the lemon juice?

☐ YES ☑ NO

18. Why do you think that? _____

_____

_____

_____

19. What do you think happens to the baking soda? _____

_____

_____

20. If you put some sugar together with some flour and mixed them together, what do you think would happen?

- ☐ the sugar would disappear
- ☐ the flour would disappear
- ☐ they would become sticky
- ☑ nothing would happen
- ☐ I don't know

21. Do you know what a molecule is? _____

_____

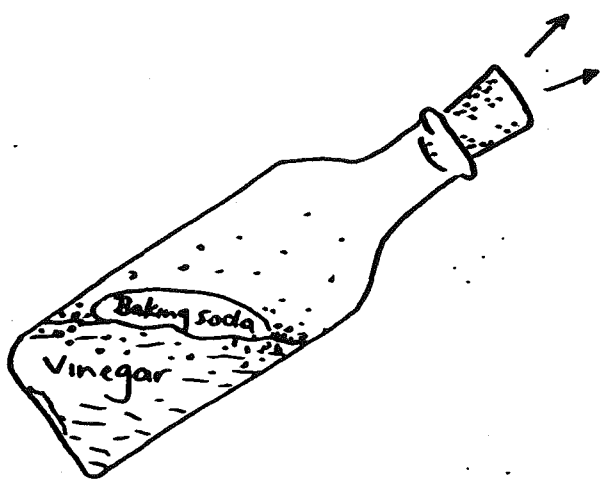
_____

_____

22. A piece of chalk looks as though it is just a solid piece of chalk, but it is really made up of

- ☑ molecules
- ☐ crystals
- ☐ gases
- ☐ I don't know

23. What makes the cork pop out of the bottle?



_____

_____

_____

_____

You're doing well. Great!

24. Which is bigger?

- ☐ an atom
- ☑ a molecule
- ☐ I don't know

25. If you looked at piece of paper through a very strong microscope, could you see

- ☐ the atoms
- ☐ the molecules
- ☐ both the atoms and the molecules
- ☑ neither the atoms or the molecules
- ☐ I don't know

26. This is what happens when you put baking soda into an acid. Fill in the missing name.

Acid + carbonate = CO_2 + salt + water

carbon dioxide

27. When wood burns, there is a chemical reaction between the wood and

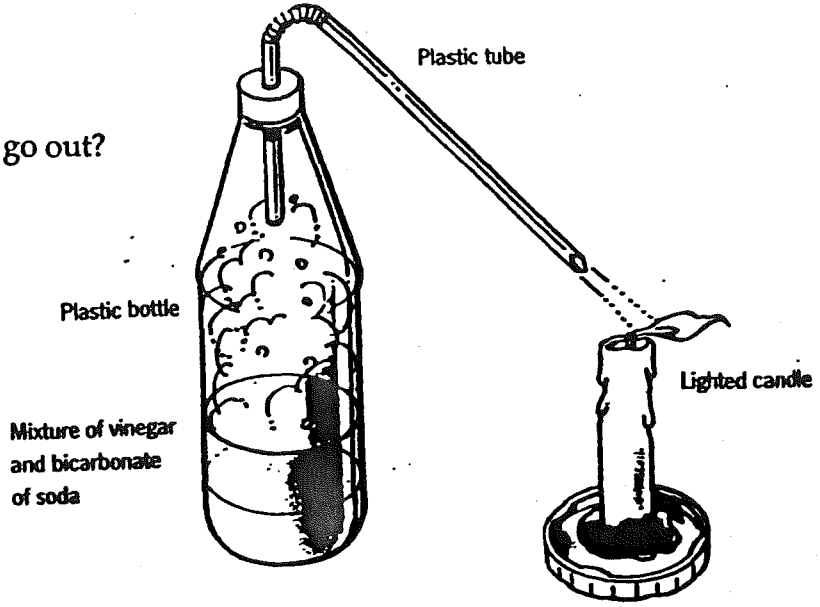
- ☐ the sap in the wood
- ☐ heat in the flame
- ☑ the oxygen in the air
- ☐ I don't know

28. Some of these are physical reactions and some of them are chemical reactions. Put a tick beside those that are chemical reactions.

281 ☐ boiling water to make steam
282 ☑ putting chalk in vinegar to make bubbles
283 ☐ dissolving sugar in warm water
284 ☐ putting milk on Weetbix to make them soft
285 ☑ putting baking soda in a cake to make it rise

Keep trying → you're doing great!

29. Why does the candle go out?



30. If you put two different things (like vinegar and chalk) together and there is a chemical reaction between them, you can never get them back again. Do you know why? _____

31. Here is the chemical formula for water: H_2O

Do you know what the O means: oxygen

32. Here is the chemical formula for **sodium** - **Na**

and here is the chemical formula for a **chloride** - **Cl**

If we put them together we get

the chemical formula for **sodium chloride** - **NaCl**

The formula for **sodium chloride** tells you that it is

- ☐ an atom
- ☑ a molecule
- ☐ an electron

? ??

33. Sometimes when the sun is shining, you can see specks of dust floating in the air. One of those specks of dust is

- ☐ about the same size as a molecule
- ☐ about twice as big as a molecule
- ☐ about 100 times as big as a molecule
- ☑ about 5,000 times a big as a molecule
- ☐ I don't know

34. Here is the formula for carbon dioxide: CO_2
How many atoms are there in carbon dioxide?

- ☐ five
- ☑ three
- ☐ two
- ☐ one
- ☐ I don't know

35. One of the gases in the air that we need to keep alive is

- ☐ carbon dioxide
- ☐ nitrogen
- ☑ oxygen
- ☐ I don't know

36. If you mixed water (H_2O) together with carbon dioxide (CO_2), the result would be:

$H_2O + CO_2 =$

- ☐ $CHCl_3$
- ☐ HSO_3
- ☑ H_2CO_3
- ☐ I don't know

You've made it almost to the end. Congratulations!

Do you think you'll find this topic on Fizzes and chemicals and molecules and atoms

- ❑ very interesting
- ❑ a little bit interesting
- ❑ a little bit boring
- ❑ very boring

Do you think you'll find this topic on fizzes and chemicals and molecules and atoms

- ❑ very hard to understand
- ❑ a little bit hard to understand
- ❑ mostly easy to understand
- ❑ very easy to understand

What is your favourite subject at school this year?

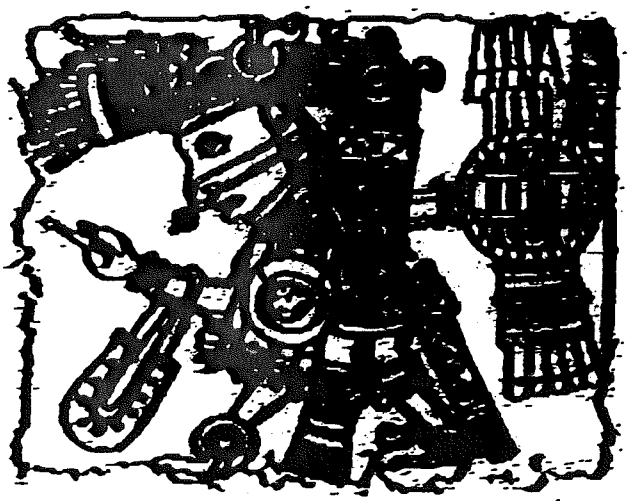
Thank you for finishing this test

If you are waiting for others to finish, you could draw a picture of a chemical here:

Appendix 9

Post-test Study 18 Aztecs unit

Learning about the Aztecs



Please try to answer all the questions

Your name _____

Your room _____

October 2000

Please try to answer all the questions

1. What is the best way to describe a myth?

- ❑ It's a story that is not true
- ❑ It's a story about important events in the past
- ❑ It's a story about magic and evil creatures
- ❑ I don't know what a myth is.

2. Where did the Aztec people live?

- ❑ South America
- ❑ Africa
- ❑ Mexico
- ❑ Russia
- ❑ I don't know.

3. Almost all the people who live in Mexico speak

- ❑ English
- ❑ German
- ❑ French
- ❑ Spanish
- ❑ I don't know.

4. The Aztecs are a people who are most closely related to

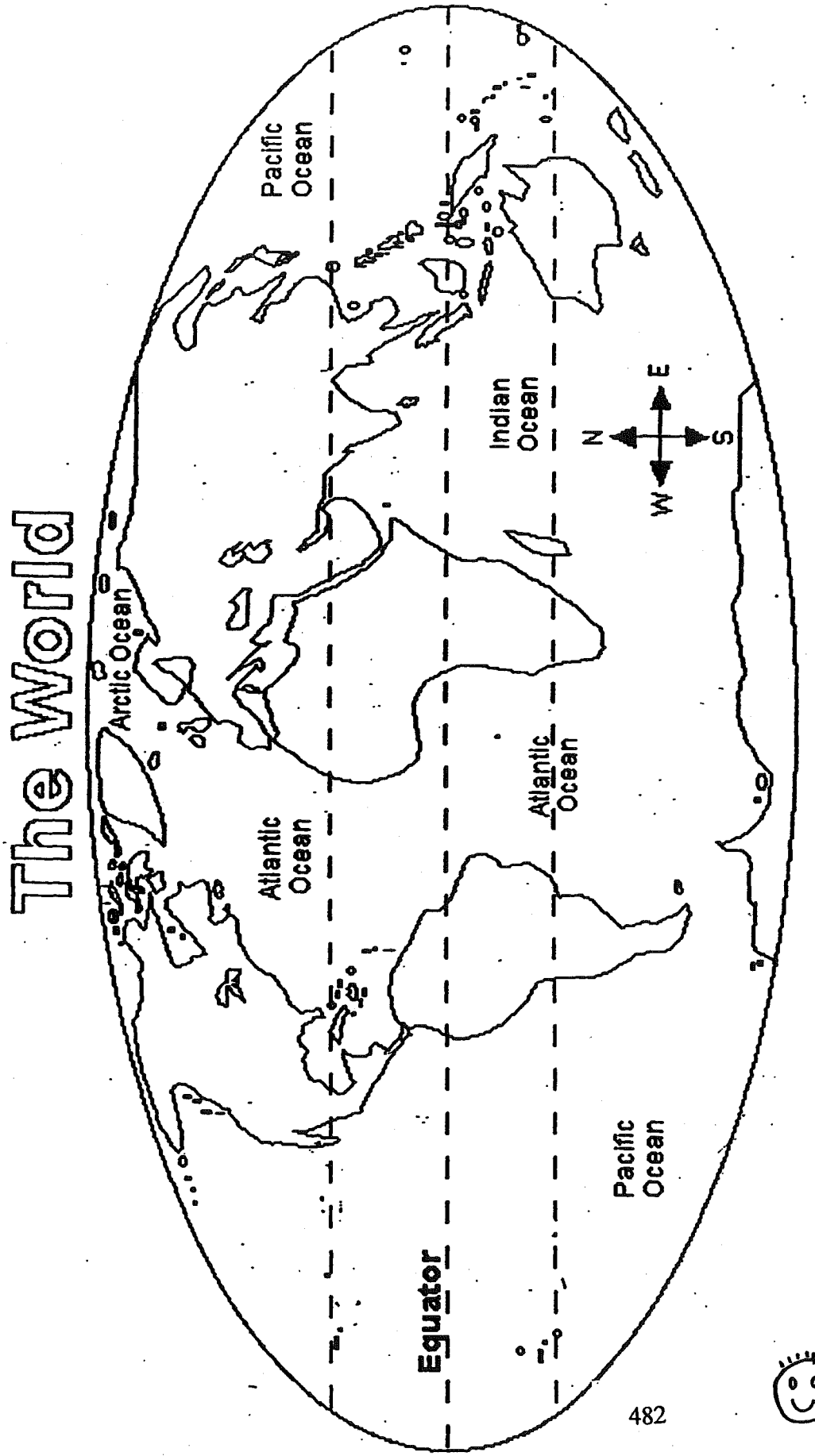
- ❑ the Asian people from China.
- ❑ the African peoples.
- ❑ the North American Indians.
- ❑ the European peoples.
- ❑ I don't know.

5. The Aztecs were people who were

- ❑ peace loving and had few wars.
- ❑ almost always fighting wars.
- ❑ involved in two very big wars.
- ❑ I don't know.

Please wait before you turn over

6. On this map of the world, put an X in the place where the ancient Aztecs lived



7. Aztecs girls soon learned that people thought they were

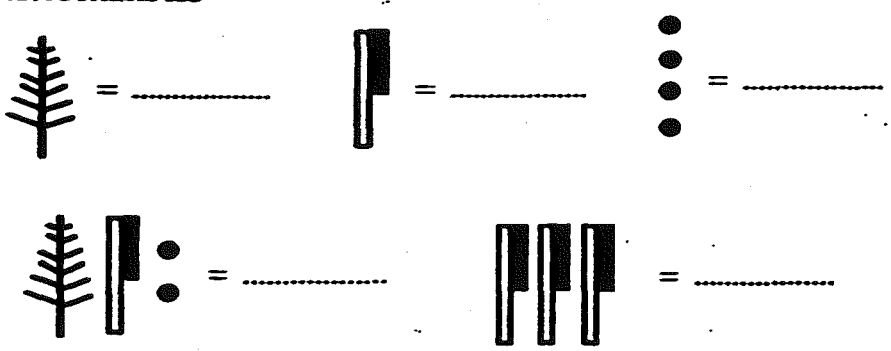
- ❑ more important than boys
- ❑ just about as important as boys in most things
- ❑ not as important as boys
- ❑ I don't know.

8. How do we know about the life of the Aztec people?
(tick one or more)

- ❑ from the stories told to their great-great-grandchildren
- ❑ from uncovering the remains of some of their temples.
- ❑ from finding some of their treasures buried under the sea
- ❑ from the libraries where they stored their printed books.
- ❑ from the stories written by their Spanish conquerors.
- ❑ I don't know.

9. Answer these questions about

Aztec numbers



10. Like many different nations, the Aztecs, had a story about how the world was created. In the Aztec story

- ❑ the gods had to try five times before they could create this world.
- ❑ the earth was carried down from heaven by a giant eagle.
- ❑ the earth was created from the coiled up body of a great snake.
- ❑ I don't know.

Please wait before you turn over

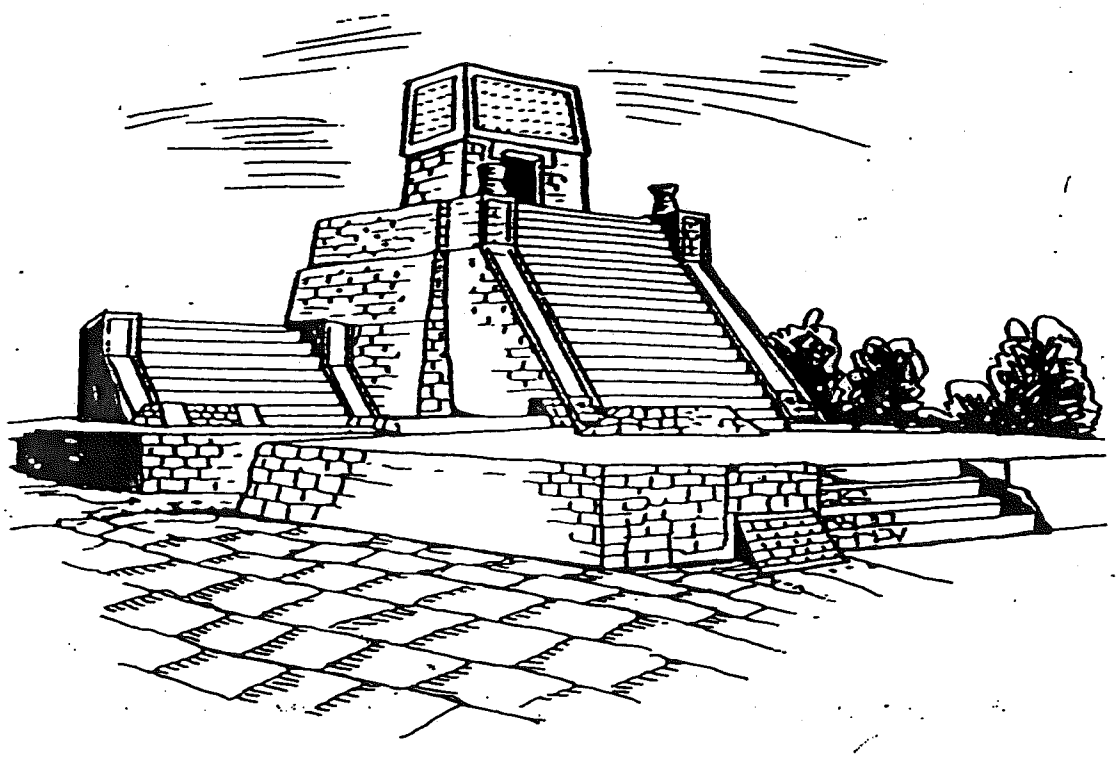
11. The most important reason why the Aztecs were always fighting wars with their neighbours was because they needed

- ❑ more food to feed their people
- ❑ more and more land to grow their crops
- ❑ more people to sacrifice to the gods
- ❑ I don't know.

12. The great Aztec city of Tenochtitlan was built

- ❑ on top of a very high hill
- ❑ in a deep valley between high mountains
- ❑ on an island in the middle of a lake
- ❑ I don't know.

13. This is the picture of an Aztec temple.



What do you think the flat space at the top was used for?

- ❑ For praying to the great god of the sun
- ❑ For lighting a sacred fire that burned all night
- ❑ For taking the heart out of a human being
- ❑ I don't know

Please wait before you turn over

14.

This is a picture of an Aztec warrior.
He is dressed up to look like

- ❑ the leaves in the forest
- ❑ the great god of war
- ❑ a jaguar
- ❑ I don't know.

15. In their myth about the return of the great god Queztalcoatl, the Aztecs mistakenly thought the god had turned into

- ❑ the Spanish invader, Cortes
- ❑ his evil brother Tezcatlipoca
- ❑ a golden eagle with the head of a man
- ❑ I don't know.

16. The Aztecs believed that if they did not sacrifice to the great god Huitzilopochtli every day

- ❑ the volcanoes would erupt and destroy their city
- ❑ a great flood would come and drown their people
- ❑ the sun would disappear and never return
- ❑ I don't know.

17. Which of these was the most important food for the Aztecs

- ❑ sweet potatoes
- ❑ wheat and barley
- ❑ sweet corn
- ❑ I don't know.

Please wait before you turn over

18. What else did the Aztecs eat and drink?

Yum!

- ❑ chili peppers
- ❑ cucumbers
- ❑ tea
- ❑ chocolate
- ❑ tortillas
- ❑ honey
- ❑ ice cream
- ❑ beans
- ❑ horse meat
- ❑ cheese

19. The great Aztec city Tenochtitlan had a very large market where thousands of people came every day. Why did this great city have such a large market?

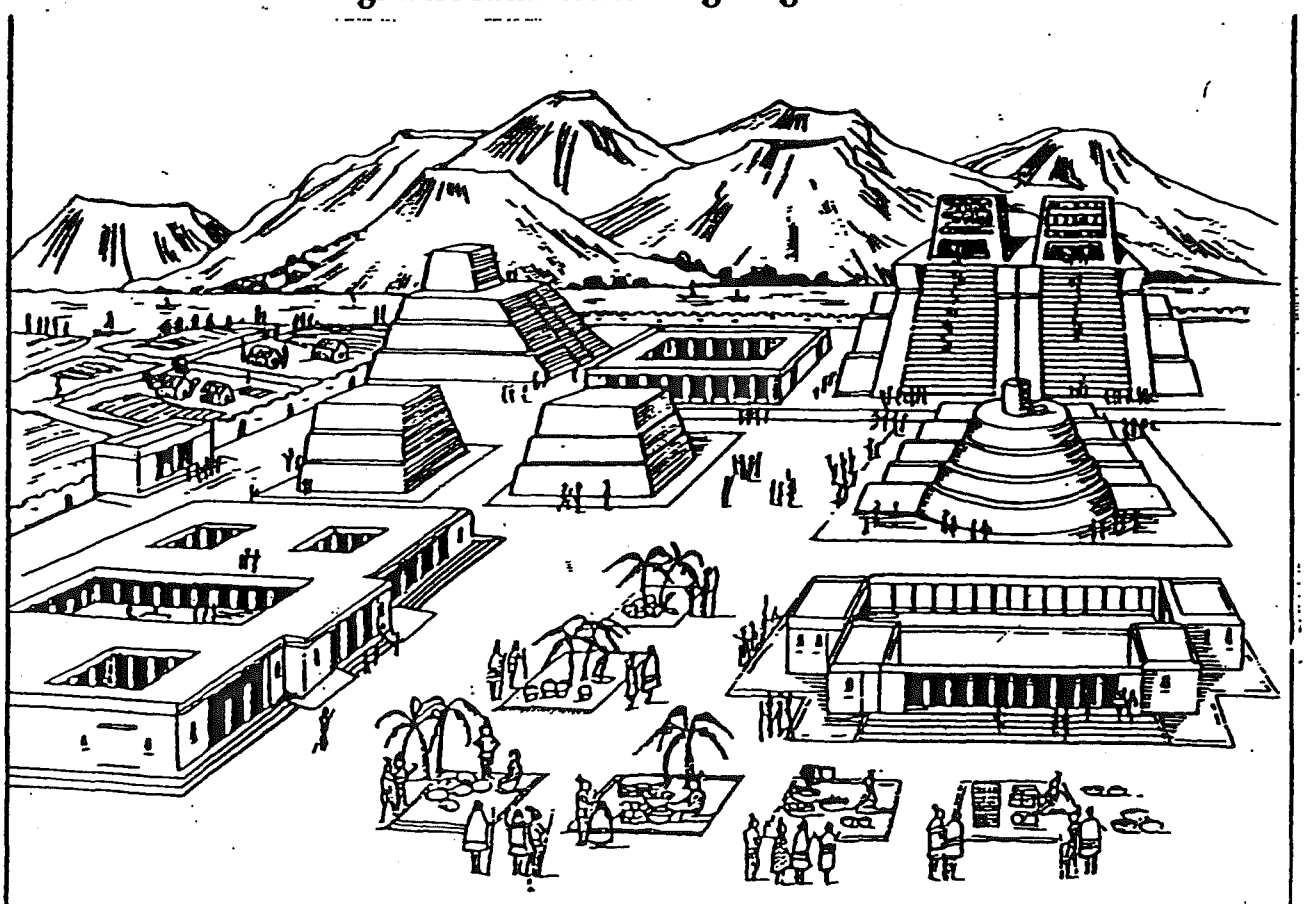
_____

_____

_____

_____

20. **In this picture of an Aztec city, draw a large arrow pointing to the place where human beings were sacrificed to the great god.**



Please wait before you turn over

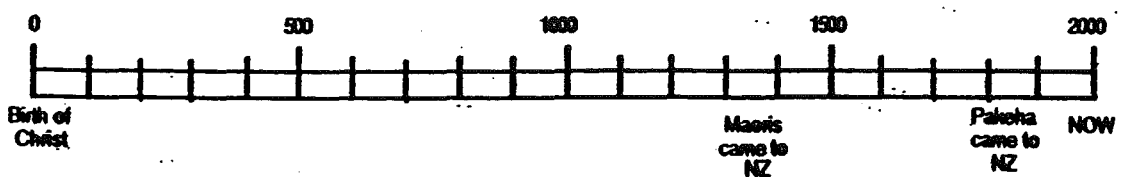
21. In Aztec society

- ❑ only the girls went to school
- ❑ only the boys went to school
- ❑ both the girls and the boys went to school
- ❑ there were no schools
- ❑ I don't know.

22. In Aztec myths, the gods talk to ordinary people

- ❑ beside sacred streams.
- ❑ through the sound of the wind.
- ❑ in their dreams.
- ❑ I don't know.

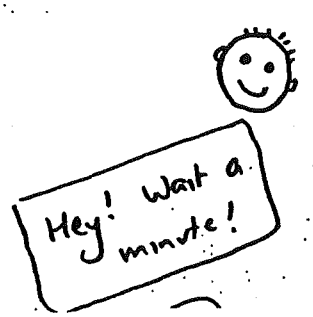
23. On this time line, colour in the squares that show when the Aztec civilisation existed.



24. In the boxes underneath the 'Emperor or King' right in the numbers of the people who were below them

Emperor or King

1. slaves
2. common people
3. rope makers
4. gold ornament makers
5. judges
6. criminals
7. nobles
8. city rulers



25. The nobles (pipiltin) were the only people who

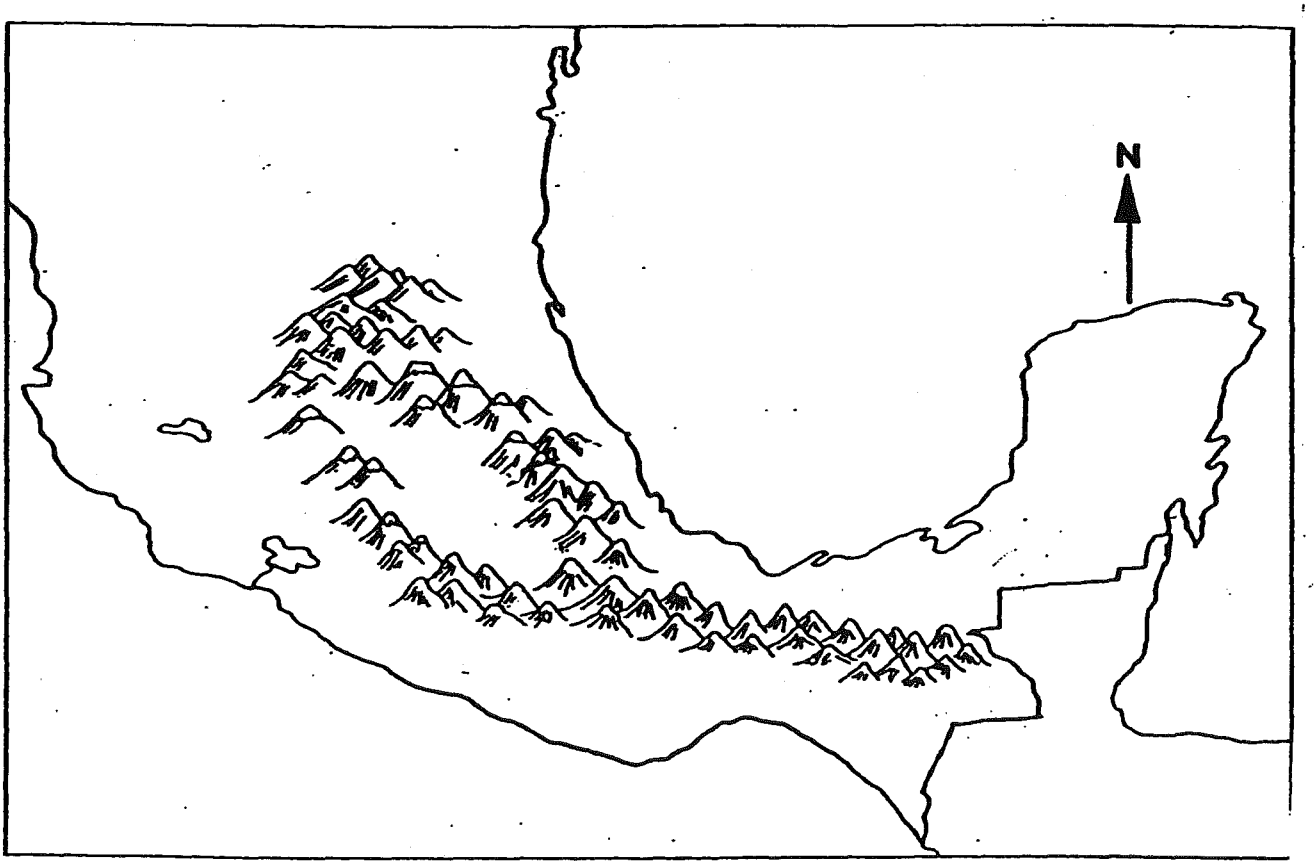
(tick one or more)

- ❑ were allowed to own land
- ❑ could be appointed as a king
- ❑ could make sacrifices to the gods
- ❑ were allowed to learn to read
- ❑ could fight in the wars
- ❑ were allowed to wear brightly coloured clothes

26. According to one of their myths, the Aztec people were told to build their great city wherever they found

- ❑ a flowering tree growing out of a large rock.
- ❑ a river flowing out of a hole beneath a mountain.
- ❑ an eagle happily eating a snake.
- ❑ I don't know.

27. Here is a map of Mexico. Mark (with a cross) where on this map the great Aztec city of Tenochtitlan was located.



28. There were schools that were for the ordinary people (telpochcalli). In these schools they taught the children

(tick one or more)

- ❑ arithmetic and how to use money
- ❑ what to do the please the gods
- ❑ how to fight in the wars
- ❑ how to read and write
- ❑ how to cook corn and sew clothes.

29. In the great Aztec city of Tenochtitlan there was a huge market where people came to trade from all the surrounding districts. How could they have a large market when they did not have money? _____

_____

_____

_____

_____

30. What were the things that were traded in the huge market in Tenochtitlan

(tick more than one)

- ❑ coloured feathers
- ❑ iron nails
- ❑ wheels for carts
- ❑ sheep
- ❑ gold ornaments
- ❑ milk and cheese
- ❑ books
- ❑ wheat flour
- ❑ brass pots
- ❑ chocolate beans
- ❑ tobacco
- ❑ harnesses for horses
- ❑ fish
- ❑ dog meat
- ❑ chili peppers
- ❑ woven mats

Please wait before you turn over

31. Put a tick beside the things you think were part of life in Ancient Egypt and life among the Aztecs

	Aztecs	Ancient Egyptians
Large pyramid shaped tombs or temples	❑	❑
Preserved their dead as mummies	❑	❑
Used coloured feathers to decorate clothes	❑	❑
Had slaves to do the hardest work	❑	❑
Sacrificed people to their gods	❑	❑
Were always at war with their neighbours	❑	❑
Invented money (coins) for trading	❑	❑
Told myths about how the world began	❑	❑
Believed their leader was a god	❑	❑
Used pictures for writing messages	❑	❑

32. If you could meet an Aztec who lives in the great city of Tenochtitlan today, What would you most like to ask the Aztec? _____

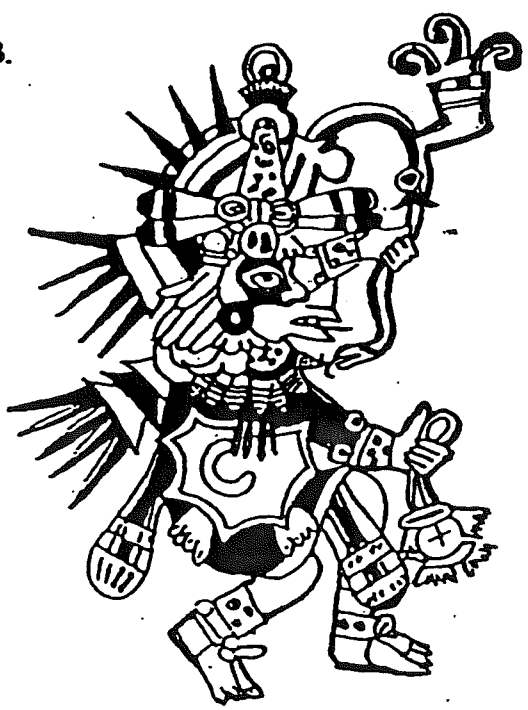
_____

_____

_____

_____

33.



In this picture the figure is covered in feathers and is holding a snake. This is a picture of

- ❑ the emperor Motecuhzoma
- ❑ a priest doing a sacred dance
- ❑ the great god Quetzalcoatl
- ❑ I don't know

34. Among the Aztecs, girls and boys were trained to do different things. Boys learned to fight in wars, to make and use tools, and to read. Girls learned to cook, weave cloth and make clothes, and to dance.

Sonya said it was good that Aztec children learned different things because boys are good at some things that girls cannot do, and girls are good at some things that boys cannot do.

Vicky disagreed. She said girls can do anything, and it wasn't fair that they should not be allowed to do what they wanted to do.

Sally agreed with Sonya but for a different reason. She thought it was good that Aztec children learned different things because then boys and girls wouldn't be competing with each other, and brothers and sisters wouldn't fight.

Melanie agreed with Vicky. But she said it was because children were all different. They should learn to do what they could do best, no matter whether they were a girl or boy.

I agree with (tick one or two)

- ❑ **Sonya**
- ❑ **Vicky**
- ❑ **Sally**
- ❑ **Melanie**

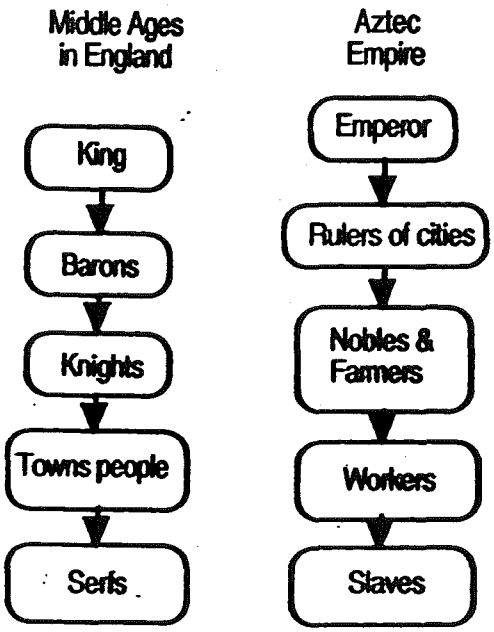
Please wait before you turn over

35. Many societies in the past were hierarchical. People's lives are controlled by other people above them.

In the middle ages in England, if you were a serf, your life was controlled by a knight, and his life was controlled by his baron or lord, and so on.

In Aztec society ordinary people's lives were controlled by the nobles or farmers. Their lives were controlled by the rulers of the cities, and so on.

In our society, except for the government that we elect, our lives are not controlled by anybody. So long as we obey the law, we can do what we like.



Would you rather live in a hierarchical society like the Aztec's, or in a democratic society like ours?

YES

NO

Explain why? _____

_____

_____

_____

_____

36. Why do you think the Aztec people liked having an Emperor to govern them?

_____

_____

_____

_____

What do you think?

Have you ever studied or read about the Aztecs before? YES NO

Where did you read or study about them? _____

_____

_____

_____

How interesting will it be for you, studying the lives of the Aztec people?

- ❑ It will be very exciting
- ❑ It will be very interesting
- ❑ Some of it will be interesting
- ❑ Mostly it will be a bit boring
- ❑ I expect all of it to be boring
- ❑ I would rather be studying something quite different

What do you think will be the most interesting thing you will learn about the Aztecs? _____

_____

_____

_____

_____

What would you most want the learn about the Aztecs? _____

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Thank you for trying so hard